POLITÉCNICO DE LEIRIA | ESCOLA SUPERIOR DE TECNOLOGIA E GESTÃO

**Thesis**

**Master in Product Design Engineering**

# Launching Innovative products to the marketplace: a strategic marketing plan for the ADHD Data Bracelet “App”

Ahmad Alsalem

Leiria, October 2021

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Thesis developed under the supervision of Susana Rodrigues, professor at the School of Technology and Management of the Polytechnic Institute of Leiria

Leiria, October 2021

# ORIGINALITY AND COPYRIGHT

*To the founder of Global Platform for Syrian Students*

*Jorge Fernando Branco de Sampaio*

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Finally, thanks to all those that directly or indirectly helped me to realize this project, thank you.

# ABSTRACT

Attention Deficit Hyperactivity Disorder, better known as ADHD, is a neurodevelopmental disorder that causes inattention, or excessive activity and impulsivity in people affected by it. Nowadays, 5-8% of global children and 4% of the adult population have ADHD. This disorder can cause a sense of inadequacy and discomfort, especially in young people who begin school and approach social activities. Common symptoms include restlessness, difficulty in focusing or staying organized, and impulsivity. Those with an ADHD diagnosis also exhibit difficulty sitting still or engaging in quiet activities. An individual may be diagnosed with one of the three different presentations of ADHD: predominantly inattentive, predominantly hyperactive-impulsive, or a third a combination of both.[1]

**Research objectives:**

**a)** In-depth understanding of the ADHD disorder.

**b)** Product design of the ADHD Data Bracelet App.

**c)** Develop a strategic marketing plan through market analysis and a questionnaire for ADHD experts that aims to understand if the product designed can be a good tool to address ADHD issues.

Therefore, it is important to develop a product that would help people with ADHD, in the hopes of improving their quality of life. The current research attempts to develop a strategic marketing plan for an ADHD mobile application. This product will contain information about ADHD based on data from psychologists, doctors, neurologists, and behavior coaches/experts. The app will be used by parents and teachers to help them better understand this disorder and its effect on children's behavior both at home and in school.

The app will be connected to a bracelet (like a smartwatch). Parents and teachers insert tasks and activities and will program the notification/alert system of the bracelet. The bracelet user will sense a pulse or ring to remind him/her of a task. At the end of the day, the app displays whether the tasks required for that day were performed by the child. This determines whether the child receives a reward.

The app is programmed to send a notification at random to the bracelet. The bracelet will receive the name and image of emotion. The app will display information about a specific emotion. Parents can now explain the image that appeared in the notification of the bracelet.

[1] https://en.wikipedia.org/wiki/Attention_deficit_hyperactivity_disorder

This feature of the product will make children learn and understand more about emotions, and later, be able to express themselves better.

The app will contain a “discussion area” to connect parents and teachers with mental health professionals. Everything related to ADHD can be asked, and the mental health professional will provide help. Parents can also share their experiences and advice with other parents.

The methodology used to develop this thesis is based on primary and secondary data, it has a strong base of literature such as academic paper, articles, books, videos, and it is also based on the data collected through a questionnaire submitted to 34 ADHD experts. The questionnaire is made of 16 questions focused on the app features and characteristics that the expert has to valuate as effective or not effective to address ADHD specific issues. Another objective is that of understating if the doctor or the psychologist that treats ADHD is willing to use the product to test its effectiveness.

For the ADHD innovative app to succeed in the marketplace, it is important to draw a strategic marketing plan, to understand the environment, the market, the competition, and potential customers (segmentation and targeting) to develop the product SWOT analysis, contextual analysis (PESTEI), the market value and the marketing mix (4Ps) as well as a schedule for launching the product.

**Keywords:** ADHD, New Product, Marketing Plan, Bracelet, App

# RESUMO

Perturbação de Hiperatividade e Défice de Atenção (PHDA) é uma perturbação do desenvolvimento neurológico que causa desatenção, ou actividade excessiva e impulsividade nas pessoas por ela afectadas. Actualmente, 5-8% das crianças em todo o mundo e 4% da população adulta sofrem de PHDA. Esta perturbação pode causar uma sensação de inadequação e desconforto, especialmente nos jovens que iniciam a escola e se deparam com actividades sociais. Os sintomas comuns incluem inquietação, dificuldade em concentrar-se ou manter-se organizado, e impulsividade. Pessoas diagnosticadas com PHDA também apresentam dificuldade em ficar quietas ou em se envolverem em actividades mais calmas. Um indivíduo pode ser diagnosticado com uma das três diferentes formas de PHDA: predominantemente desatento, predominantemente hiperactivo-impulsivo, ou uma combinação de ambas.

**Objectivos da investigação:**

a) Compreensão profunda da doença de PHDA.

b) Concepção do produto A Pulseira de Dados PHDA App.

c) Desenvolvimento de um plano estratégico de marketing através de análise de mercado e de um questionário para especialistas em PHDA que visa compreender se o produto concebido pode ser uma boa ferramenta para abordar as questões de PHDA.

Por conseguinte, é importante desenvolver um produto que ajude as pessoas com PHDA, na esperança de melhorar a sua qualidade de vida. A investigação actual tenta desenvolver um plano estratégico de marketing para uma aplicação móvel de PHDA. Este produto conterá informação sobre PHDA baseada em dados de psicólogos, médicos, neurologistas e técnicos/especialistas em comportamento. A aplicação será utilizada por pais e professores para os ajudar a compreender melhor esta perturbação e o seu efeito no comportamento das crianças, tanto em casa como na escola.

A aplicação será ligada a uma bracelete (como um relógio inteligente). Os pais e professores inserem tarefas e actividades e programarão o sistema de notificação/alerta da bracelete. O utilizador da bracelete sentirá uma vibração ou um som para o lembrar de uma tarefa. No final do dia, a aplicação mostra se as tarefas necessárias para esse dia foram executadas pela criança. Isto determina se a criança recebe uma recompensa.

A aplicação é programada para enviar uma notificação aleatória à bracelete. A bracelete receberá o nome e a imagem da emoção. A aplicação irá exibir informação sobre uma emoção específica. Os pais podem agora explicar a imagem que aparece na notificação da bracelete. Esta característica do produto fará com que as crianças aprendam e compreendam mais sobre as emoções, e mais tarde, sejam capazes de se exprimirem melhor.

A aplicação irá conter uma "área de discussão" para conectar pais e professores com profissionais de saúde mental. Tudo relacionado com a PHDA pode ser questionado, e o profissional de saúde mental irá prestar auxílio. Os pais podem também partilhar as suas experiências e conselhos com outros pais.

A metodologia utilizada para desenvolver esta tese baseia-se em dados primários e secundários, tem uma forte base de literatura, tais como publicações académicas, artigos, livros, vídeos, baseando-se também nos dados recolhidos através de um questionário enviado a 34 especialistas em PHDA. O questionário é constituído por 16 questões centradas nas funcionalidades e características da aplicação que o especialista tem de avaliar como eficazes ou não eficazes para abordar questões específicas da PHDA. Outro objectivo é o de compreender se o médico ou o psicólogo que trata a PHDA está disposto a utilizar o produto para testar a sua eficácia.

Para que a aplicação inovadora da PHDA tenha sucesso no mercado, é importante desenhar um plano estratégico de marketing, para compreender o ambiente, o mercado, a concorrência, e os potenciais clientes (segmentação e orientação) para desenvolver a análise SWOT do produto, a análise contextual (PESTEI), o valor de mercado e o marketing mix (4Ps), bem como um calendário para o lançamento do produto.

**Palavras-chave** PHDA, Novo Produto, Plano de Marketing, Bracelete, Aplicação

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# LIST OF SYMBOLS

**ADHD**- Attention-Deficit/hyperactivity Disorder

**CTP**- Continuous Performance Test

**ODD**- Oppositional Defiant Disorder

**ED**- Emotional Dysregulation

**DSM**- Diagnostical and Statistical Manual of Mental Disorders

**e.g.**- exempli gratia

**i.e**.- id est

**CD**- Conduct Disorder

**ANX**- Anxiety

**PESTEI**- Political, Economic, Technological, Environmental, International Analysis

**SWOT**- Strengths, Weaknesses, Opportunities, Threats Analysis

**GDP**- Gross Domestic Product

**PPP**- Purchasing Power Parity

**EU**- European Union

**CAER**- Compound Annual Growth Rate

**HAS**- Haute Autorité de Saudé

**NICE**- Health and Care Quality of the United Kingdom

**US**- United States

**UK**- United Kingdom

**SAMHSA**- Department of Drug Abuse and Mental Health Services

**FDA**- Food and Drug Administration

# 1. INTRODUCTION

The main goal of the thesis is to fully understand ADHD and to present a product in line with the needs of children and adolescents who are diagnosed with the disorder and to develop a marketing plan to launch the ADHD Data Bracelet App. The thesis also aims to understand consumers' needs, wishes, and how they might react to the ADHD Data Bracelet App.

This thesis aims to develop a strategic marketing plan to launch an innovative product to the marketplace: the ADHD Data Bracelet "App".

The thesis will be divided into seven chapters.

The first chapter introduces the topics to be explored in the thesis.

The second chapter will focus on a critical review of the ADHD literature, to understand its causes, main problems, and methods of care and treatment. This literature review will allow the development of the product features that will be explained in the following chapters.

The third chapter presents the ADHD Data Bracelet App product, its main features, and functions, explaining how they can be useful to deal with the disorder.

The fourth chapter is dedicated to the marketing plan for the launch of the new product, analyzing the methods to cope with ADHD, the market size, the targets, the competitors, and the strategies to be used to introduce the ADHD Data Bracelet App on the market.

The fifth chapter introduces the research methodology used within the thesis that aims to sustains the market research conducted to test the expert's acceptance of the product and their future willing to adopt it with their ADHD patience.

The sixth chapter analyzes and discuss the results of the study conducted in this thesis.

Finally, the seventh chapter illustrates the conclusions of the study.

## 1.1 The motivation of the study

As a product design engineer, my goal is to create products that can improve the lives of the people who use them. Knowing about a complex disorder like ADHD, what struck me most was its complexity and articulated diffusion. After numerous researches and becoming aware of the difficulties that children and adolescents have to face it every day, I developed the concept of the ADHD Data Bracelet. The main purpose is to make the school and daily activities of all those who have the disorder as easy as possible.

Another important goal that I want to achieve through this thesis and the ADHD Data Bracelet App is to spread awareness among teachers, professors, and parents of the disorder itself since, as it emerged in my research, ADHD is still surrounded by misconception and misunderstanding.

## 1.2 The aim of the study

To develop the ADHD Data Bracelet App, a fundamental theoretical basis was necessary for the understanding of ADHD, since only through the study of its causes, characteristics, and problems it was possible to create a product capable of dealing with the disorder.

The thesis aims to create a product that can be used by those who have ADHD and to create a marketing plan for launching that product on the market.

In the thesis, it was fundamental to analyze ADHD in all its forms to achieve a careful analysis of all the problems that the ADHD Data Bracelet App will try to solve.

The analysis of the literature was important to deep understand the meaning of ADHD and the research allowed the elaboration of an effective marketing plan.

Another main purpose of the following study was to understand, through a specific questionnaire to doctors, which functionalities would be important to reflect in the bracelet to accommodate the people with the disorder needs.

The questionnaire was applied to:

a) Understand the product functionalities.
b) To test expert's product acceptance and understand if they will adopt the ADHD Data Bracelet App in the future.

## 1.3 The Methodological Basis of the Study

The research methodology of this thesis uses both a primary and secondary data collection approach. The secondary data relies on the analysis of books, academic articles, reports, official websites, and videos concerning the topics of ADHD, the realization of a marketing plan to understand the concept and its context.

The collection of primary data was carried out through the administration of one questionnaire to doctors, neurologists, and experts of ADHD with the objective of understanding the product features and to collect their opinion on the product.

The questionnaire submitted to experts has 16 questions and was answered by 34 experts.

# 2. ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD)

## 2.0 Chapter introduction

This chapter is based on the literature review of the main articles about the ADHD disorder. To develop a product that will be used to help those with a disorder that complicated it was necessary to study and analyze ADHD under all its point of view and characteristics.

The main topics of this chapter will be ADHD definition, the main characteristics of ADHD, its main causes, the diagnosis of the disorder, comorbidity, and all main ADHD issues from emotion management to learning difficulties.

## 2.1 ADHD definition

According to Polanczyk et al. (2014), ADHD stands for Attention-Deficit/Hyperactivity Disorder, a neurodevelopmental disorder that causes inattention, hyperactivity, and impulsivity in children that have it. Nowadays ADHD is clinically divided into three different groups: predominantly inattentive, predominantly hyperactive-impulsive, and combined types (Barkley 1997).

For Mowlem et al. (2019) attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder marked by age-inappropriate and insufficient levels of inattention and/or hyperactivity/impulsivity. Rowland et al (2002) affirm that ADHD is not only the most commonly diagnosed neurodevelopmental condition but also the most investigated. He continues by saying that even if this disorder is largely diffused, the prevalence of ADHD varies based on race/ethnicity, sex, age, and socio-economic status. One explanation is that challenges in the diagnosis of ADHD have resulted in difficulties in establishing an acceptable case description for epidemiological research. Diagnosis depends primarily on parent and teacher reports; no laboratory analysis predicts ADHD accurately. Prevalence rates for ADHD are subject to who is asked what and how the information is combined.

Barkley affirms that 3-7% of the childhood population has ADHD, with boys being more affected than girls and with a 50-80% of cases in which the disorder persists into adolescence and adulthood (30-50%). Walker et al. (2011) support what Barkley said through a study that shows how an important part of ADHD symptomatology persists into adolescence.

Teenagers who have been diagnosed with ADHD since adolescence tend to be at particular risk for co-morbid psychology, mental illnesses, and learning disabilities. These findings remain apparent despite initial management of the disorder and persistent use of medicine during puberty.

After understood what ADHD is, and how it is defined under a scientific point of view, to develop a product that aims to treat its main issues it was important to proceed understanding its main characteristics.

### *2.1.1 Main characteristics of ADHD*

Barkley (1997) points out how much ADHD is strongly connected to poor academic achievement, retention in grade, school expulsions, low peer and family relations, anxiety, and depression, aggression, delinquency, early substance abuse, reckless driving behavior, difficulties in adult social relationships like marriage and employment.

In addition to what was said by Barkley, Rowland et al. (2002) affirm that children diagnosed with ADHD use medical and mental health services more often than children without this disorder.

Polanczyk et al. (2007) describe ADHD as a disorder characterized by symptoms of inattention, hyperactivity, and impulsivity.

For Barkley (1997) ADHD is nothing but a deficit in behavioral inhibition that affects mainly four executive neuropsychological functions that are normally regulated by the prefrontal lobe:

1. Working memory,
2. Self-regulation of affect-motivation- arousal,
3. Internalization of speech,
4. Reconstitution (behavioral analysis and synthesis).

### *2.1.2 ADHD causes*

To create a product that can help parents and teachers with children that present an ADHD diagnosis it is essential to understand the causes of such a complex disorder. Only by knowing what is at the origin of ADHD, we can build a product that will be able to improve the daily life of those with this disorder.

ADHD, according to Barkley (1997), is a mainly genetic disorder, for Castellanos (2001) quoted by Rowland et al. (2002) is caused by dysfunction and dysregulation of cerebellar-striatal/adrenergic-prefrontal circuitry.

Although ADHD has been studied since the early 1900s, the causes of this disorder and the areas affected by it are still not 100% clear. Citing various studies Rawland et al. (2002) state that the area of the brain most affected by ADHD is the right prefrontal one. These findings were made using neuroimaging images a new technology that has various limitations. The involvement of other areas cannot be excluded because not all areas of the brain have been studied and the statistical sample under investigation is not sufficiently large. It is important to underline the fact that these studies are made on children not considering the age-related developmental changes.

Like Barkley, Waldman, and Rhee (2002) also suggest a strong genetic component of ADHD and this statement is confirmed by clusters of ADHD in families and, as reported by Biederma et al (1992), 34-40% of subjects with ADHD have one or multiple family members with the same disorder.

The genetic component is also supported by various studies carried out on twins by Goodman and Stevenson (1989) who, cited by Rowland et al. (2002), have shown that the concordance for hyperactivity is greater among monozygotic twins than in dizygotic twins: concordance for clinically diagnosed hyperactivity is in 51% of monozygotic and 33% of dizygotic.

As stated by Swanson et al. (2001), recently some molecular genetics studies have been able to identify another cause that influences ADHD: two dopamine transporter polymorphisms and some dopamine receptor genes. Dopamine transporter polymorphism is more closely related to impulsivity and the dopamine receptor gene is more closely related to inattention (Waldman et al., 1998; Rowe et al., 1998, quoted by Rowland 2002). This research on polymorphisms has led to the conclusion that many genes are likely involved in the transmission of ADHD.

However, numerous other studies look for the causes of ADHD even outside of genetics, for example since the 50s various studies relate low birth weight to ADHD: babies born between 1,500 and 2,500 grams are at increased risk of ADHD (Rowland et al., 2002).

Another risk factor has been identified by Rawland et al (2002), in the toxic environment to which the fetus may be exposed, including various toxic substances, solvents, pesticides, or metals such as mercury that cross the placenta and are excreted in breast milk. Another cause could be smoking during pregnancy, a factor repeatedly linked to the risk of ADHD.

### *2.1.3 ADHD diagnosis*

Weinberg and Brumback (1992), cited by Rowland et al. (2002) point out how the continuous change in the definition of ADHD over the past 20 years has made it difficult to reach a single diagnosis of the disorder.

During the past 20 years, various diagnostic models for ADHD have been proposed by the Diagnostic and Statistical Manual of Mental Disorders (DSM). The DSM-III-R has focused on ADHD with and without hyperactivity. The DSM-IV, set the stage for differentiating primarily inattentive children from those who are primarily hyperactive and impulsive, adding a combined category for those who are both inattentive and impulsive/hyperactive.

Till 2013 the DSM-IV was the standard model used to diagnose ADHD and unlike previous versions, which allowed ADHD to be present in just one environment, it requires both symptoms and impairment of those symptoms to be present at least in two contexts (school and home) and not just in one (Rowland et al., 2002). The fact that the symptoms must be present in two distinct environments makes the diagnosis more precise, preventing a child with a conflicting relationship with a particular teacher or parent from being diagnosed with ADHD. Another important element of the DSM-IV is that symptoms must persist for at least 6 months and according to the American Psychiatric Association (1994) must be accompanied by "clinically significant" damage that occur before 7 years of age (Rowland et al., 2002).

Today the DSM V is the updated diagnostic method for ADHD and follows the diagnostic criteria shown in Table 2.

*Table 1-DSM V*[2]

| Inattentive Type | Hyperactive/impulsive Type |
|---|---|
| Symptoms and/or behaviors that have persisted>6 mo in >2 settings (e.g school, home, church). Symptoms have negatively impacted academic, social, and/or | Symptoms and/or behaviors that have persisted>6 mo in >2 settings (e.g school, home, church). Symptoms have negatively impacted academic, social, and/or |

[2] https://www.qandadhd.com/

<table>
<tr>
<td>occupational functioning. In patients aged <17 y, >6 symptoms are necessary; in those aged <17 y, >5 symptoms are necessary.<br>A. Displays poor listening skills<br>B. Loses and/or misplaces items needed to complete activities or tasks<br>C. Sidetracked by external or unimportant stimuli<br>D. Forgets daily activities<br>E. Diminished attention span<br>F. Lacks the ability to complete schoolwork and other assignments or to follow instructions<br>G. Avoids or is disinclined to begin homework or activities requiring concentration<br>H. Fails to focus on details and/or makes thoughtless mistakes in schoolwork or assignments.</td>
<td>occupational functioning. In patients aged <17 y, >6 symptoms are necessary; in those aged <17 y, >5 symptoms are necessary.<br>Hyperactive symptoms<br>A. Squirms when seated or fidgets with feet/hands<br>B. Marked restlessness that is difficult to control<br>C. Appears to be “driven by a motor” or is often “on the go”<br>D. Lacks the ability to play and engage in leisure activities in a quiet manner<br>E. Incapable of staying seated in class<br>F. Overly talkative<br>Impulsive symptoms<br>A. Difficulty waiting turn<br>B. Interrupts or intrudes into conversations and activities of others<br>C. Impulsively blurts out answers before questions completed</td>
</tr>
<tr>
<td colspan="2">Additional requirements for diagnosis</td>
</tr>
<tr>
<td colspan="2">Symptoms presented before age 12 y<br>Symptoms not better accounted for by a different psychiatric disorder (e.g. mood disorders, anxiety disorder) and do not occur exclusively during a psychotic disorder (e.g. schizophrenia)<br>Symptoms not exclusively a manifestation of oppositional behavior</td>
</tr>
<tr>
<td colspan="2">Classification</td>
</tr>
<tr>
<td colspan="2">Combined type: Patient meets both inattentive and hyperactive/impulsive criteria for past 6mo<br>Predominantly inattentive type: Patient meets inattentive criterion, but not hyperactive/impulsive criterion for past 6mo<br>Predominantly hyperactive/impulsive type: Patient meets hyperactive/impulsive criterion, but not inattentive criterion for past 6mo.</td>
</tr>
</table>

A diagnosis for ADHD is made in close collaboration with parents and teachers, who play a key role because of close contact with the child. For Barkley (1998) teachers, having a good sense of appropriately developing children's behavior and being able to compare the behavior of a child with that of others in the class, are particularly valuable informants. Sometimes the diagnosis of a teacher or a parent can be more useful and accurate than that

of a doctor because, according to Cantwell (1996) cited by Rowland, the diagnosis of ADHD should be made in an evolutionary context because the symptoms of ADHD are not always evident in highly structured contexts like a psychologist office, so the evaluation of parents and teachers can be more valuable that those made during an office visit or interview. Precisely because of what has often been said, ADHD is also diagnosed by pediatricians or other primary care providers, not by psychologists or psychiatrists (Rowland et al., 2002).

It is important to consider the fact that very often ADHD is not the only disorder that the child might have, because it might be accompanied by another disorder, giving rise to what is called a co-morbid situation (Rowland et al., 2002).

### *2.1.4 Comorbidity*

Comorbidity makes the diagnosis of ADHD difficult because ADHD could be confused with symptoms of other disorders. Among the most common comorbid conditions are learning difficulties, oppositional defiant disorder (ODD), conduct disorder (CD), Tourette's syndrome, depression, anxiety disorders (ANX), and bipolar disorder (Biederman et al., 1991; Cantwell, 1996; Barkley, 1998).

According to Shaywitz (1991), the approximate estimates of comorbidity rates among all people worldwide with ADHD are around 10% for reading disabilities, 27% for anxiety disorders (Biederman et al., 1991), and 25% -40% for oppositional defiant disorder/conduct disorder.

The high rate of comorbidities is a fact that cannot be ignored in the making of an ADHD product. If in most cases those with ADHD may have other disorders the product in question must have a broad spectrum of action, that is, it has characteristics capable of providing solutions to ADHD, but also to other disorders such as dyslexia or anxiety that occur in comorbidities (Newcorn, et al.,2001).

Abikoff et al. (2000) concluded that in children diagnosed with ADHD + ANX, without ODD/CD comorbidities, inattention measures do not differ much from children diagnosed with ADHD alone, so in this case, it may be more difficult to diagnose even anxiety. It is equally difficult to diagnose ADHD in those children diagnosed with ODD or CD as the symptoms of these two disorders could hide or confuse those of ADHD.

Newcorn et al. (2001) conducted a study on comorbidity based on the Continuous Performance Test (CPT) that measures when the ADHD group was limited to cases without

comorbidity. This study was conducted among four hundred ninety-eight children from the NIMH Collaborative Multisite Multimodal Treatment Study of Children with Attention-Deficit/Hyperactivity Disorder (MTA). From this study, it came out that children with ADHD+ANX may be less impulsive and more prone to develop an adverse effect on medication treatment, so behavioral therapy might have better results.

Interesting findings concern the ADHD + ODD/CD and ADHD + ANX + ODD/CD groups which appear to be more impulsive than the group of children diagnosed only with ADHD. Those diagnosed with only ADHD and ADHD + ANX demonstrate a higher level of inattention and a lower level of impulsivity and hyperactivity. Instead, children with ADHD + ODD / CD have higher levels of inattention and impulsivity than hyperactivity. Finally, in children with ADHD + ODD/ CD + ANX, the three symptom domains did not differ significantly from each other.

Walker et al. (2011) state that today, after years and years of study, psychiatric comorbidities seem to be the norm rather than the exception among adolescents diagnosed with ADHD. Co-morbidities ODD and/or CD have been reported in 30-45% of children diagnosed with ADHD by age 15, anxiety was evident in 30% of the same sample, while rates of depression and bipolar mood disorder were 45% and 23%, respectively.

In cases of comorbidity, there seems to be a prevalence of symptoms related to inattention because hyperactive and impulsive attitudes become less and less evident with the development and growth of the child with ADHD, while those of inattention remain constant (Walker et al., 2011).

ADHD is not always diagnosed correctly and therefore it is important to consider this aspect as well and try to make a product that is not harmful to the child or adolescent even in the event of a wrong diagnosis. The ADHD Data Bracelet, unlike drugs, cannot be dangerous for those who use it even after a misdiagnosis, but needs to be aware of the comorbidity aspect because its function should be able to address other disorders' issues.

### *2.1.5 ADHD treatment*

According to Rowland, the most widely used medical treatments for ADHD are stimulant drugs, which seem to have the greatest effect on a disorder whose cure is not yet known. These stimulants can be accompanied by psychosocial interventions, especially if there are comorbid disorders. Treatment of ADHD is controversial due to the high prevalence of drug treatment.

Following a careful analysis of the literature, it can be concluded that a correct diagnosis of ADHD is essential to understand which drug treatment the child undergoes, especially taking into account the possible side effects that these medicines can have.

In cases where ADHD is diagnosed without the presence of other disorders, the best treatment seems to be through stimulant drugs. When there are comorbid situations, pharmacological treatments should be accompanied by behavioral therapies and psychosocial interventions (Rowland et al., 2001)

Rowland et al. (2001) conclude by pointing out that treatment with stimulant medications can have numerous side effects such as sleep disturbance and loss of appetite in a significant minority of children, increases anxiety in some, and is unsuitable or ineffective in treating other disorders in a comorbid situation.

## 2.2 Introduction to some of the ADHD issues that will be assisted to help those with ADHD diagnose

According to the research mentioned, there are 3 main types of ADHD diagnosis, and an individual may be diagnosed with one of the three different presentations of ADHD: predominantly inattentive, predominantly hyperactive-impulsive, or third a combination of both.

After studying ADHD in general, from different sources and scientific papers, there was the need to find a solution to raise awareness around the children diagnosed with ADHD and their environment to give an undirect method to educate them about their disorder and see the positive and the negative aspects of it. Therefore, it was essential to develop a questionnaire for experts in this area (ADHD) to ensure that the product designed would have been effective, usable, and could have been a support for professionals in the diagnosis of ADHD. It was essential to also understand which features the product should embrace, however the product features will be mentioned in the next chapter.

The questions that were asked in the questionnaire are about emotions, attention, distraction, self-control, anger management, and learning, the main characteristics of ADHD that will be deeply explained in the following pages, while the questions and their outcomes will be reported in the research part.

### *2.2.1 Emotions*

As already explained before, emotional management is one of the major issues a child with ADHD has to face. To understand the solution provided by the ADHD Data Bracelet App to help children with managing their emotions it is important to understand what emotions are and why they play a key role in their daily life.

According to Bunford et al. (2015) emotions are reactions to a stimulus or stimuli that involve both a biological response and a conscious and subjective one.

Emotions can be described as the response that everyone has to external stimuli. There are many different kinds of emotions that influence how we live and interact with others. At times, we can appear to be controlled by these feelings. The decisions we make, the actions we take, and the expectations we have are all affected by the emotions we feel at any given moment.

From a first analysis, emotions can be separated into simple emotions and combined emotions.

### *2.2.2 Basic Emotions*

In the 1970s, psychologist Paul Eckman described six basic emotions that he suggested were commonly experienced in all societies. The emotions he had described were happiness, sadness, disgust, fear, surprise, and anger. Later, he extended his list of basic emotions to include such topics as pride, shame, embarrassment, and excitement.[3]

### *2.2.3 Combining Emotions*

According to psychologist Robert Plutchik, emotions can be mixed to form various emotions, as colors can be combined to produce other shades. According to this hypothesis, the most fundamental feelings are behaving like building blocks. More complex, often mixed emotions are the combining of these simpler emotions. For example, simple emotions like joy and trust can be combined to create love.

### *2.2.4 ADHD and emotions*

According to Christiansen et al. (2019), emotions are temporally limited qualitative states associated with changes in feelings, expression, and physiology. Preliminary research suggests that one of the characteristics associated with a social disorder in people with

[3] https://www.verywellmind.com/an-overview-of-the-types-of-emotions-4163976

ADHD is emotional dysregulation (ED) and there is evidence that ADHD and ED are each associated with risky activities, such as drug misuse and risky sex.

Bunford et al. (2015) show that in addition to difficulty in controlling anger, frustration, and other negative emotions, some young people with ADHD also face difficulties in managing positive emotions. For example, a 15-year-old teenage male with ADHD can respond to a positive announcement in his class by activity jumping up from his chair and sitting down repeatedly, clapping, and raising his voice with enthusiasm. In response, his peers are likely to view him as childish, immature, and strange, and therefore eventually (given repeated instances of this sort of behavior) socially reject him.

According to Plwcevic et al. (2020), children with ADHD have a poorer degree of understanding of their own emotions and higher behavioral problems than children who do not have this disorder. This also influences the understanding of other people's feelings, conveyed not only by their language content but also through their facial expression and how they express their emotional message by words.

### *2.2.5 Emotion recognition and understanding in children with ADHD*

Children with ADHD best recognize the joy and sadness of normal children. They have a greater understanding of joy than all other feelings.

The average of children without ADHD was most sensitive to the recognition of sadness, then joy, threat, anger, and the least sensitive to the recognition of fear and command. ADHD children's best-recognized joy and then sadness, fear, command, anger, and threat were the worst. The only emotion in the speech that children with ADHD understand in the same manner as children without the disorder is joy, a positive emotion (Plwcevic et al., 2020).

Danger and threat are the most difficult emotions for children with ADHD to identify and this could explain why they adopt dangerous and reckless behaviors that are not perceived as such unlike children and adolescents who do not have this disorder.

Furthermore, while joy and sadness have well-defined facial expressions and with them well-defined behavioral patterns, this is not the case for order and threat. The child with ADHD can identify and understand their joy and that of others because when a person is happy, smiles, laughs, while for the threat there are no facial expressions or vocal expressions that make it easy to identify.

### *2.2.6 Emotional awareness in ADHD*

According to Factor et al. (2016), children with ADHD often demonstrate poor emotional self-awareness and higher levels of externalizing behavior issues relative to unaffected children. This difficulty may be linked to deficits in working memory and information processing, which in children with ADHD lead to erroneous interpretation of their emotions. For these reasons, children with this disorder react inappropriately to various situations that cause social difficulties. Children with ADHD have stronger and more variable emotional responses that make it much more difficult to regulate their emotions and engage in goal-oriented behaviors such as not responding badly to a call from the teacher for not being sent to the principal. Additionally, impulsivity in children with ADHD hinders their ability to inhibit negative behavior.

## 2.3 Attention

Attention is another of the main problems that characterize ADHD and to understand how to solve this problem, a considerable literary study was necessary.

According to Tucha et al. (2017), children and adults with ADHD have remarkable deficits in selective attention and divided attention and that because inattention signs, such as distractibility and difficulties with concentrating, are central manifestations of ADHD (Shahaf et al, 2018).

Inattention suggests that an individual wanders away from the job, loses persistence, has trouble keeping concentration, and is disorganized, and these difficulties are not due to disobedience or lack of understanding. Sometimes, people with signs of inattention can:

- Overlook or forget knowledge, make careless errors in schoolwork, at work, or during other events,
- Had trouble paying attention to tasks or playing, like discussions, lectures, or prolonged reading.
- Not listening when someone is speaking directly to him or her.
- Not obey orders and not complete schoolwork, activities, or duties in the workplace or initiate assignments, but lose concentration immediately and sidetrack easily.

- Have problems finishing tasks but also organizing them, because is difficult to do activities in sequence, keep materials in order, have efficient time management, and meet deadlines.
- Avoid tasks that require long mental effort.
- Lose things necessary to complete tasks.
- Be easily distracted by unrelated stimuli.
- Be forgetful in daily activities[4].
- Daydream and forget about "here and now"[5].

## 2.4 Distraction

According to Ross et al. (2016) distraction is a typical component of any classroom environment. For effective instruction and learning to take place, it is critical for students to eventually return to tasks and maintain task vigilance (i.e., returning to the task at hand) when a distraction occurs. Considering this phrase distraction is something very common, that affects everybody especially in school and working environments, the only difference is that students and workers with ADHD are more distractible than those that do not have the disorder. To be more precise those with ADHD have more difficulties in disengaging from the distracting stimulus and returning to tasks (i.e., maintaining task vigilance).

To avoid distractions in their classes, teachers can use several strategies that can help especially students with ADHD. One of these strategies can be breaking down instructional periods and assigned work into smaller sections of time, providing instructional cues and reminders to return to the task. Another strategy can be that of allowing the child to move around the class more so that once he/she will return to his/her sit can be more focused and ready to complete an exercise.

## 2.5 Self-control

According to Koi (2020) individuals with ADHD have reduced self-regulation, and thus, whether there is a hereditary or neurodevelopmental etiology for this decreased ability, the control criterion for responsibility is not completely fulfilled. However, It is important to

[4] https://www.nimh.nih.gov/health/topics/attention-deficit-hyperactivity-disorder-adhd/index.shtml
[5] https://www.webmd.com/add-adhd/childhood-adhd/attention-deficit-hyperactivity-disorder-adhd

emphasize that self-control is a complex and broad construct with a wide range of behaviors, and not all of them are significantly difficult for those with ADHD.

It should also be emphasized that the problem of self-control varies from individual to individual: some people with ADHD seem to be successful in tasks, careers, and projects that place strong demands on their self-control, while others have more difficulties. Some adults have serious impairment in the educational, occupational, dating, marital, and financial (impulsive shopping) spheres and others do not.

Environment has a robust role in the constitution of self-control. This is also true for self-control in persons with ADHD. Of course, the behavior of people with ADHD is partly explainable by their genes and brains, in addition to their environments. But since this is a trivial fact in that it pertains to all human behavior, it is not particularly useful for probing whether and how people with ADHD ought to be held responsible.

## 2.6 Anger management

According to Barkley (1997), individuals with ADHD tend to have cognitive impairments in the executive functions of the brain that are crucial for developing self-control and steering actions into the future. Impairment of these mechanisms leads to the difficulties of ADHD individuals in inhibiting their environments' immediate reactions, their inability to interrupt ongoing responses, and their difficulty in maintaining working memory information.

According to Ramirez et al. (1997), people with ADHD have reported displaying frustration in more dysfunctional ways than people without ADHD, and they also engage in less positive ways of coping with anger, such as taking time off, managing their anger, or thinking before reacting to situations that cause anger. In their research, they have observed, that when upset, women, rather than men, appeared to use more nonverbal forms of communication, but also engaged in reciprocal communication with others when faced with an anger-provoking situation. Moreover, Women registered considerably higher levels of positive and negative external effects of emotional responses than men.

Eyre et al. (2019) affirm that attention-deficiency/hyperactivity disorder (ADHD) and depression usually co-occur. Irritability is a potential cause for linking these two disorders. Children with ADHD who are also irritable can be a major at-risk category for potential depression. This is because population-based experiments have repeatedly demonstrated that

irritability is correlated longitudinally with depression. Irritability is a tendency to respond to a condition that is disproportionate to rage, grouchiness, or outbursts.

## 2.7 Learning

Mayes et al. (2000) performed a survey of over 119 children aged 8 to 16 years who were examined in an infant diagnostic center. A learning disability (LD) was found in 70 percent of children with attention-deficit/hyperactivity disorder (ADHD), with learning disorders in written language two times more common (65 percent) than learning difficulties in reading, math, or spelling.

These learning difficulties can be explained through five main points[6]:

1. **A constant need for movement**. Children with ADHD have a hard time controlling the motions of their muscles, and it can be difficult to remain still for prolonged periods. To combat this, students will make excuses to leave the classroom. As a consequence, they skip valuable instructions and exercises that could make it easier to finish tasks later. To solve this problem parents and teachers can split tasks and allow breaks in between to let the child move.
2. **Classrooms have too many external distractions.** . In a room full of other children, the number of external stimuli is growing. It's unusual to have a peaceful time. Children with ADHD are easily distracted, and the repetitive squeaking of a chair, finger tapping, or voices in the corridor will make it impossible for the kid to maintain their undivided attention to the task at hand. To solve this problem there are technology devices that can allow to turn off notification and distraction while the child is completing an assignment.
3. **Their thoughts outrun their bodies.** For students with ADHD, it is typically not a failure to learn that causes a challenge, but rather a disparity in their ability to bring that learning into their schoolwork. This can result in missed exams, difficulty doing homework or writing assignments, and a failure to turn in assignments on time. To face this problem and improve the self-awareness of the child parents and teachers

[6] https://www.brainforestcenters.com/news/5-ways-adhd-affects-learning-in-the-classroom

can offer rewards to the child and motivate him or her to complete a task and be more focused while doing it

4. **Challenges with filtering thoughts (and choosing the right time to share them).** Hyperactive-impulsive children seem to cloud their emotions before others have finished speaking. This may trigger issues with other classmates, particularly during group tasks, and may disrupt the instructor during essential training time, affecting not only the child's ability to hear orders but also lessons. Beyond that, this will affect the social life of your child. For these issues, rewards can be beneficial because if parents and teachers will prize good and positive behaviors the child will be more willing to adopt them and thoughtful before reacting to a certain situation.
5. **Thoughts tend to drift**. ADHD influences learning by inhibiting the child's ability to remain focused. Not paying attention makes it impossible to recall what the teacher said about classes, tasks, and due dates. The child's ability to understand the content and complete assignments will also suffer. To help the child with this issue parents and teachers can make him/her use an assignment notebook where he or she can write down all the most important things that should not be forgotten.

# 3. RESEARCH METHODOLOGY

## 3.0 Introduction

The main purpose of this chapter is therefore to describe the used research methodology, as well as the research proposition, the research process, and the methods chosen for the data collection and analysis. Remeny et al. (1998), cited by Holeden & Lynch (2004), underline the importance of research methodology. When starting a search, the researcher should ask himself/herself three fundamental questions: "How to search?", "What to search" and "Why the search?". Finding the answers to these questions can direct to the most appropriate research methodology for achieving the prefixed goals.

## 3.1 The research propositions

The research carried out by this thesis aims to understand how the market could react to the launch of an ADHD Data Bracelet / App, and how the product can help those who have been diagnosed with this disorder (why). To do this it was decided to use both a primary and secondary data analysis (how) aimed at seeking answers from the market to the proposed product (what).

## 3.2 Research methodology

According to Bahari, S. F. (2010) one of the hardest parts of starting research lies in the difficulty of choosing between two types of research strategies: intensive and extended. These two strategies are respectively better known as "qualitative" and "quantitative".

The difference between qualitative and quantitative research does not only concern the choice between statistical analysis and in-depth interviews, surveys or case studies or on the confirmation and replication test in fact the debate on qualitative and quantitative research in the epistemological phase is known as the wars of paradigms (Bryman, 2006: 16). As pointed out by Kuhn (1970), research approaches are based on paradigms that make different assumptions about the social world, how science should be ended, and what constitutes problems, solutions, and legitimate test criteria. Therefore, qualitative and quantitative research strategies are immeasurable according to their paradigm and their vision of the world and reflect epistemological and ontological presuppositions (Bahari, 2010).

This thesis will adopt a quantitative methodology of research.

## 3.3 Data collection methods

This thesis will follow both primary and secondary data collection, following a hybrid method of collecting data.

Primary research is knowledge obtained by self-directed research techniques, whereas secondary research is information gathered from previously performed studies.

This thesis starts with secondary research that provided the researcher with the knowledge that other researchers have already gathered through past studies. The primary analysis was adopted to cover the holes in knowledge that the secondary data collection has not been able to obtain.

### *3.3.1 Secondary data collection*

The following research began with a critical review of the medical literature regarding ADHD to fully understand the characteristics of the disorder, its causes, the impact it has on those diagnosed with it, and its best therapies.

In order to have an in-depth understanding of ADHD, literature about its causes, characteristics, treatments, and main issues has been explored and analyzed. The articles, books, and sites that were consulted are all contained in the bibliography of the thesis. All the material analyzed in the literature review was selected after careful research about the main experts of the ADHD field, were considered just official sites that reported certified information about ADHD. For the marketing and research part were used books and articles by luminaries of the field that have set the stage for research and strategic planning for years and years.

The aim of the literature review was that to prove that the ADHD Data Bracelet App has scientific background because has been developed considering medical studies and research about the disorder.

After this research, it was possible to develop and implement the idea of a product, the ADHD Data Bracelet App, capable of responding to the needs of those who have the disorder, and supporting them in the most critical situations, but also to spread knowledge and understanding.

The literature has also made it possible to identify critical points for children with ADHD, which have given rise to topics for debate and the exchange of ideas through a focus group with experts on the subject, neurologists, and doctors.

Literary research was also conducted to understand which research method to use, for the most correct way to analyze the data, and how to develop an effective and efficient marketing plan.

The main sources of the secondary data collection were academic articles suggested by specialists such as doctors consulted for the development of this thesis and, search engines such as Google Scholar, Mendeley, books about ADHD and marketing, websites about mental health conditions, and podcasts for secondary data collection.

The articles were analyzing consulting journals like “frontiers in Human Neuroscience”, International Journal of Epidemiology, European Child Adolescence Psychiatry, and the Journal of Attention Disorders, all connected with mental issues in children and adolescents.

The review of the literature was useful to lay solid theoretical foundations for the development of a product for the treatment of ADHD, for the development of an effective marketing plan, and for the choice of the research method that could best satisfy the objectives of this thesis.

The following study arises from the analysis of the literature to fully understand ADHD and its causes. This literature review lasted four months (from November to February) and led to the development of a product whose characteristics can help children and adolescents diagnosed with ADHD.

### *3.3.2 Pilot study*

A pilot study was conducted through a questionnaire submitted to 34 ADHD expert for a period of two months. The questionnaire was to be filled online through the platform google Forms. The questionnaire was sent by email with a file containing an short explanation about the product and the purpose of the research.

The experts are doctors (physicians) and neurologists who will have to answer sixteen questions that aim to understand if the features and functions of the ADHD Data Bracelet App can be useful to those who have this disorder.

## 3.4 Primary data Collection

The purpose of primary research is to address basic questions specifically relevant to the project at hand and to fill in the gaps left by the study of literature; it was decided to adopt a survey strategy since it allows data to be collected in a standardized way but studying a fairly large number of people through a questionnaire. The proposed questionnaire was completed by 34 ADHD experts that with their knowledge could prove the effectiveness of the product.

This thesis can be considered as exploratory research that uses various methods in different stages, to conduct a study as correctly as possible, and to reduce the uncertainty and error possibility.

### *3.4.1 The questionnaire for the expert*

This questionnaire aims to collect a medical and reliable opinion on the product covered by the thesis and wants to lay solid foundations for the launch of the product itself.

The sixteen questions for this survey are based on the main ADHD issues described in the first chapter: emotions, attention, distraction, self-control, anger management, and difficulty to use what learned. Most of the questions want to understand if, according to experts, the main ADHD issues could be targeted by the product functionalities.
The questionnaire was answered by 34 experts and in the following pages, all their answers will be analyzed to understand if in their opinion the ADHD Data Bracelet App could be a positive and helpful tool.

# 4. RESULTS AND DATA ANALYSIS

## 4.0 Introduction

This last section will analyze question by question the answer collected through the questionnaire and will analyze the data to understand how the product is perceived by experts and if they are willing to use it if a prototype will be realized.

## 4.1 Questionnaire results

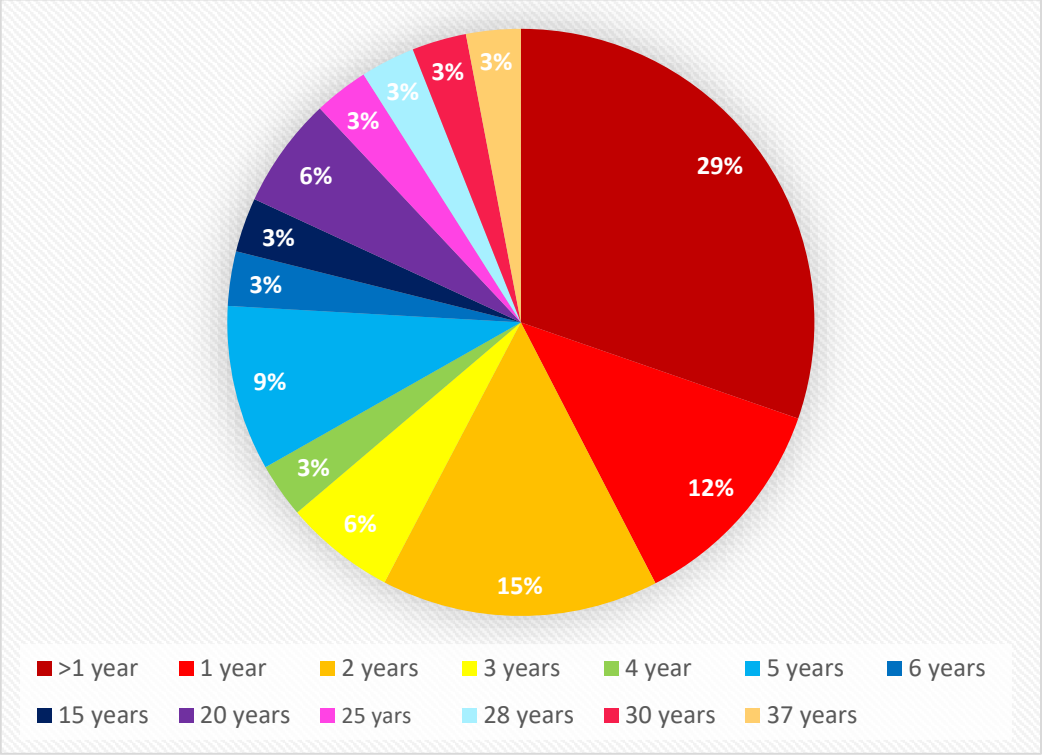
**Question n° 1**

The first question asked was about the name of the expert answering the questionnaire. It was important to ask the name to verify the identity of the experts themselves. For privacy reasons, the results of this first question will not be shared.

**Question n°2**

The second question is "Years of professional experience in the field of ADHD or dealing with ADHD". This question was asked to understand the experts' degree of experience in the ADHD field.

The results are shown in the graphic.



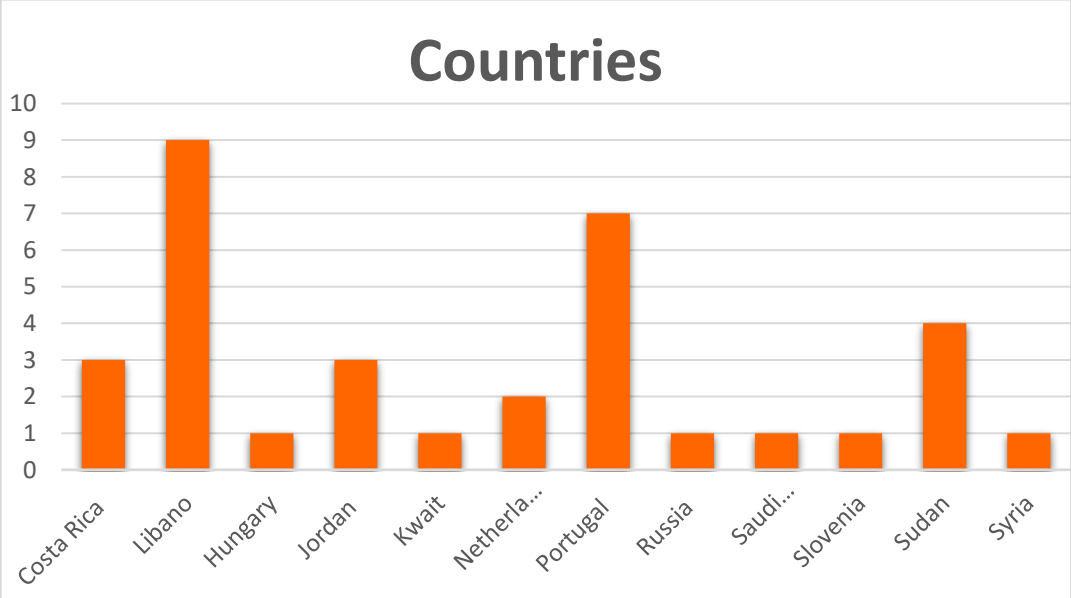

As shown by this percentage 29% of experts do not have significant experience while the 47% of experts have an experience from 1 to 6 years, 3% of 15 years, the 12 % has experience of 20 or more years and the 6 % has an experience with ADHD of more than 30 years. These

results showed us as the product has been review by true experts in the ADHD field that can identify which features could be beneficial for the child and which not.

**Question n°3**

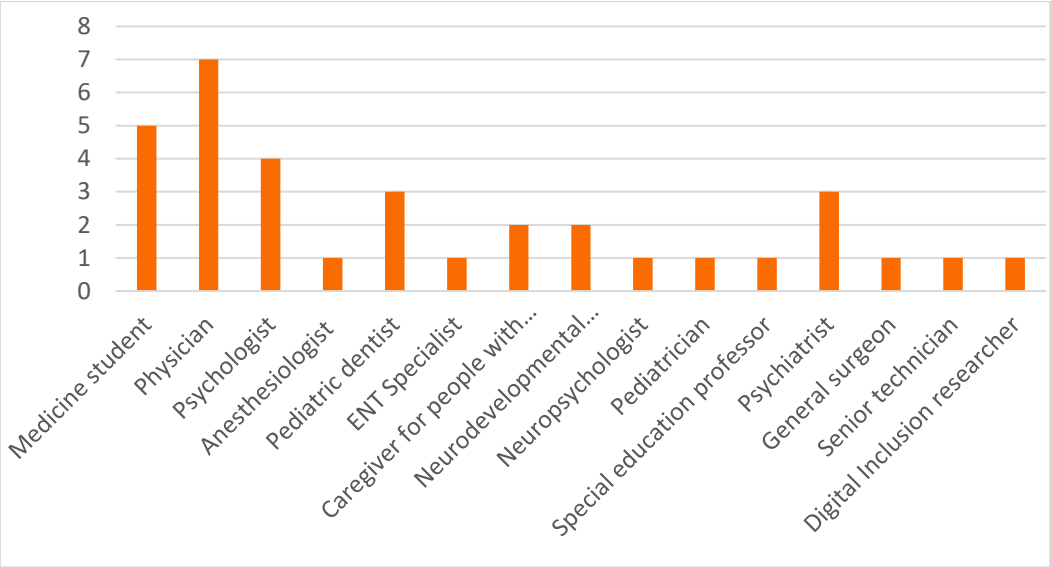
The third question is about the country of the expert that could allow me to understand how different countries perceive and deal with ADHD. From the literature review emerged the fact that ADHD is diagnosed and treated in different ways based on geographic areas, so it was important to understand how doctors perceived my product based on the place they built their experience with ADHD.

The doctors that answered the questionnaire come from 12 different countries and the results will be shown in the following graphic.




**Question n°4**

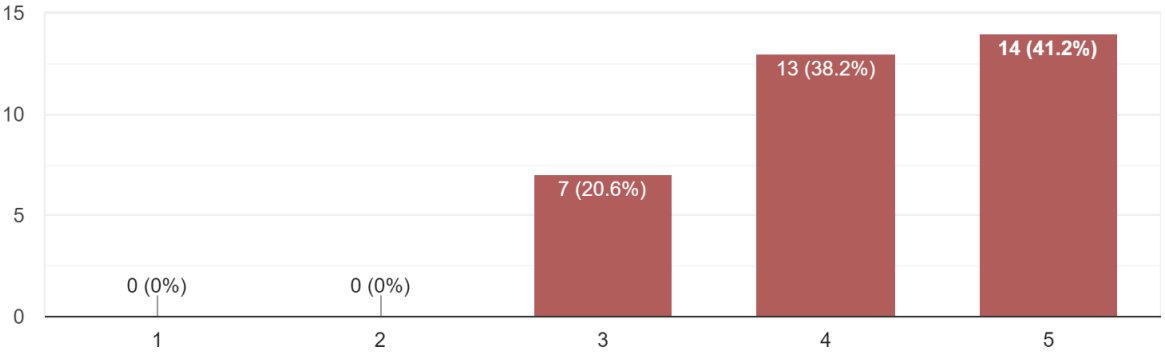
The fourth question asks to specify the experts' profession (psychologist, psychiatrist, pediatrician, etc.) to understand how doctors that come from different areas can perceive the features of my product.




As shown in the graphic the experts that answered the questionnaire come from 15 different areas but most of them are physicians and medical students and psychologists.

**Question n°5**

In order to understand if the feature of splitting tasks could be a good method to cope with attention, distraction, self-control, and learning difficulties, the following Research question was designed: "Is splitting tasks and shortening the time of the task itself, a good method to deal with distraction? Please use the scale from 1- totally disagree to 5-totally agree to state your opinion".

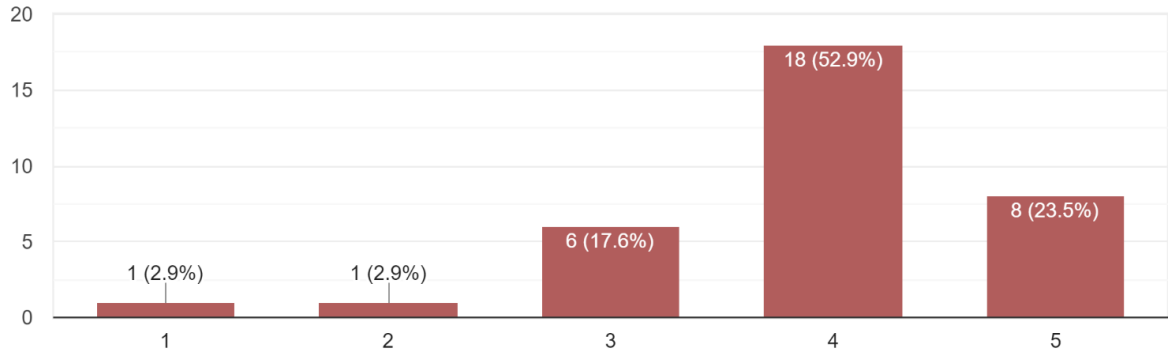



As shown in the figure most of the experts agreed that the splitting task feature is an effective method to help ADHD children with distraction and attention difficulties, 41, 2% totally agreed and the 38,2% agreed the feature to be efficient.

**Question n°6**

In order to understand if the feature of Emoji could be a good method to cope with emotion management, self-control, and anger the following Research question was designed: "The ADHD Data Bracelet will introduce emotions to children through images, to be more specific through emojis. An angry emoji will be followed by an explanation of anger, its

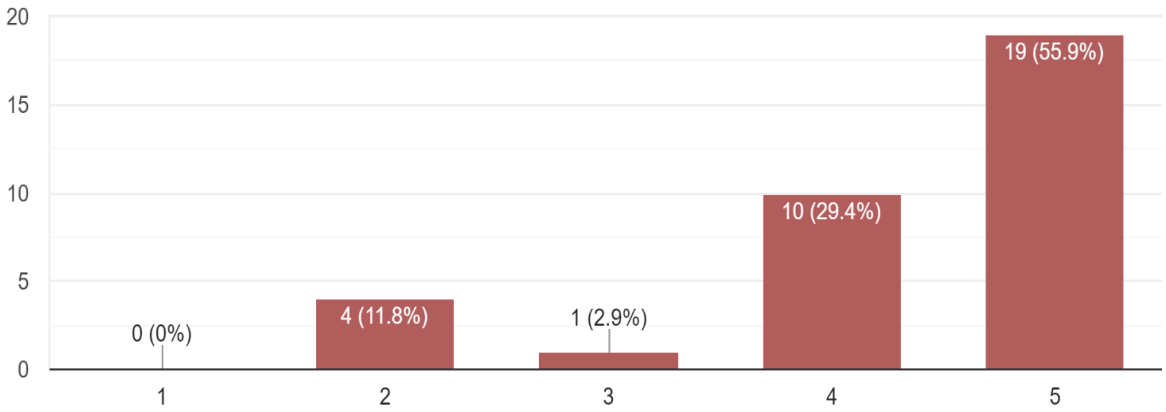
characteristics, and the effect this emotion will have on the children's body and mood. The main objective of the feature described above will be that of improving self-awareness/understanding and consequently improving mood-switching management. Do you agree this feature will be helpful to children with ADHD? Please use the scale from 1- totally disagree to 5- totally agree to state your opinion".




52,9% of experts agreed that the emoji feature is a good method to help children to understand and manage in the best way possible their emotions, while 23.5,9 % strongly agree with it.

**Question n°7**

To understand if the features of "info for parents" and "Connection with professionals" could be a good method to cope with the main ADHD issues the following Research question was designed: "The ADHD Data Bracelet App will guide children, teachers, and parents. The App also allows direct contact between professionals, experts, and parents than can exchange information with them. Do you think this feature can be useful in the App? Please use the scale from 1- totally disagree to 5-totally agree to state your opinion".



The majority of experts (55,9%) strongly agreed or agreed (29,4%) that “connection with experts” and “info for parents” both are very useful features of the product.

**Question n°8**

To understand if the features of “achievement reminders” could be a good method to cope with attention, distraction, and learning issues the following Research question was designed: “The ADHD Data Bracelet can be programmed by parents to send a notification (vibrating pulse) to remind the child of a task to accomplish. Is this an effective method of coping with memory problems? Please explain”.

Generally, the experts agreed that this function can be helpful to the child or adolescent with ADHD. Here are some of the answers:

*“Yes, I think this is an effective method because all the child needs is a reminder. When a child is continuously corrected by a teacher in front of the entire class or a parent in front of other siblings, this will negatively affect their self-confidence”*

*“Yes, especially when most kids with ADHD require multiple reminders to do their task and having the watch might be that little “hey c’mon” to keep their attention on the tasks”*

*“Yes, good if each alert tone is linked to a specific task”*

*“It is a good way to remind the child to finish the task at hand as it uses a two sensation to do that (touch and hearing) and by that "brings the child back to reality"*

Some doctors express the doubt that this system could limit child’s autonomy:

*“Maybe it allows the child to depend on the alerts to remind him/her of the tasks, and thus they won’t use their memory. Maybe at first alerts should be used, and later on, we can switch to the children themselves trying to remember their tasks”.*

This doubt can be solved through the connection with expert features: parents can set alerts with the help of professionals that can suggest to them the safest frequency with which the alerts should be sent to not “damage” the child's autonomy.

**Question n°9**

In order to understand if the features of "achievement reminders" have side effects the following Research question was designed: "The notification system described in the previous question could be an invasive approach that causes anxiety in children or parents? Please explain".

*"I don't see the possibility of getting anxiety. It would probably look the same as notifications on our mobile phones, so it would do no harm or cause stress"*

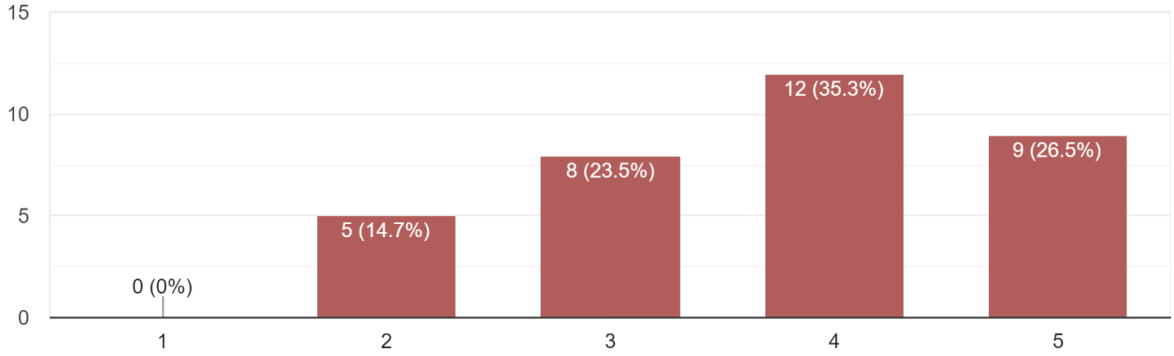
*"Not really, because they will be familiar with the product and how it works"*

*"I think overuse could cause anxiety, however, when used correctly and the child enjoys the bracelet and images, it will be a better way of reminding the child to complete a task than continuously remind him/her in front of classmates/siblings".*

As shown with the answers above, most experts agreed that the side effects can be minimized and can be controlled through the right frequency of the notification system. According to the experts' suggestions, each parent will be able to program when and how often a notification will be sent to the bracelet to avoid anxiety in the child.

**Question n°10**

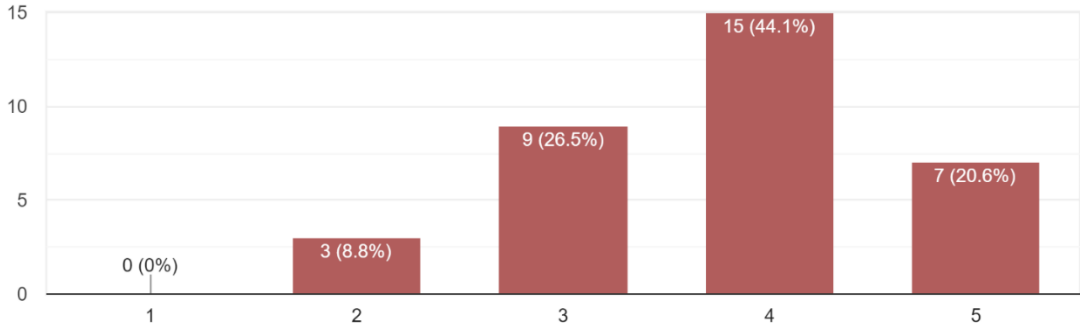
To understand if the features of "rewards" are a good method of coping with attention, distraction, self-control, and learning issues, the following Research question was designed "Parents and children will receive a notification after each task is completed. At the end of the day, parents can check the list of tasks their child accomplished and decide if he/she will have a reward. Do you think this reward system can be effective and lead to positive results? Please use the scale from 1- totally disagree to 5- totally agree to state your opinion".




The 35% of expert agreed and the 26.5% totally agrees that the reward system is an effective method to come with ADHD lack of motivation, distraction and the main issues that this feature targets.

**Question n°11**

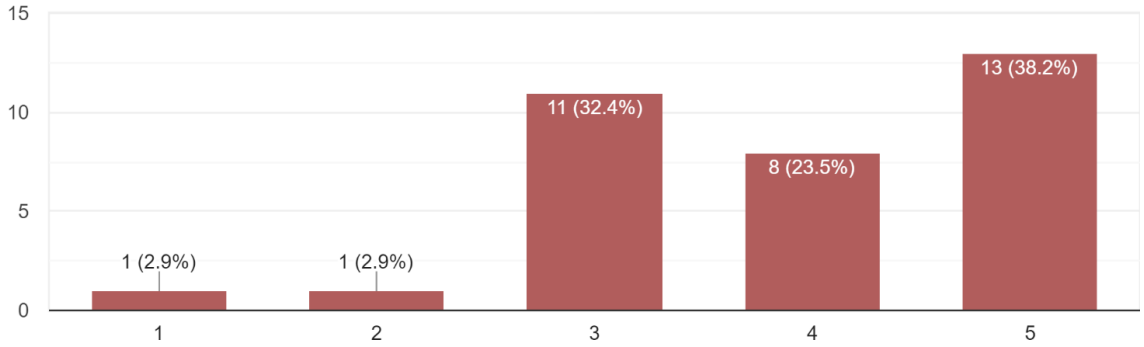
In order to understand if the product could have a future development in the ADHD adults' market the following Research question was designed: "In 45 % of children diagnosed with ADHD, the cause is genetic. To consider future developments of the product, do you think the ADHD Data Bracelet could be used both by parents and children with ADHD? Please use the scale from 1- totally disagree to 5-totally agree to state your opinion".




44,1 % of expert agreed and the 20.6 % totally agreed that the app could be used also by adults that has ADHD. For the future the app could be adapted and modified so that it could be used by parents too and that could make the bond between parents and children stronger.

**Question n°12**

To understand the opinion of the expert about the product the following Research question was designed: “Would you consider the use of this APP as a tool to address ADHD? Please use the scale from 1- totally disagree to 5-totally agree to state your opinion”.




Most expert agreed (23.5%) or totally agreed (38,2%) that the ADHD Data Bracelet App could be an effective tool to target ADHD. This is a very important data because, for the future, experts will be willing to test the product and recommend it to parents with children that has ADHD.

**Question n°13**

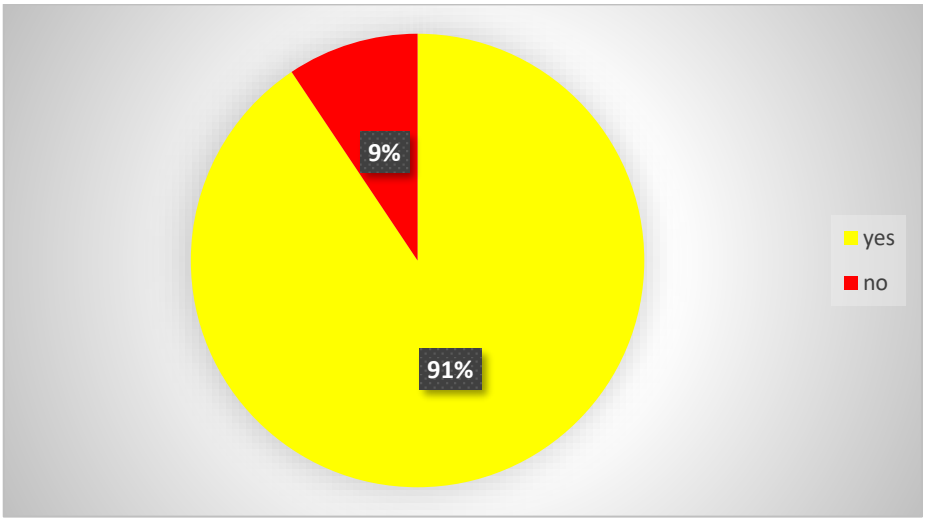
To be sure that the ADHD Data Bracelet App has no side effect the following Research question was designed: “Do you think the ADHD Data Bracelet might have any side effects? If yes, which one?”.

For this question, half of the experts answered that the product will not have side effects, while the other half identify as a negative effect the anxiety the ADHD Data Bracelet App may cause in children. However, the anxiety is agreed to be a light one and not in all children but in the ones that already suffer from this disorder.

**Question n°14**

The main objective of the ADHD Data Bracelet App is that to assist those who have ADHD through the day so to understand its compatibility with medication the following Research question was designed: “Do you think this product can be usefully combined with

medications? Do you think it could reduce the amount of medication a child with ADHD has to take?".




91% of experts consider the ADHD Data Bracelet App a good support to the ADHD treatment even dough it cannot be a substitute for medical treatment.

**Question n°15**

I wanted to have the most honest feedback from the expert and their suggestions are very important to the future of my product so the following Research question was designed: "There is something you would change or modify in the ADHD Data Bracelet App to make it better and more efficient?".

To this question experts mostly answered that to think about some changes for the product they should see a prototype and for now they would not change anything.

A psychology counselor suggested introducing a behavioral technique called "cost response".

**Question n°16**

The last question was designed to understand how the product could be marketed considering the point of view of a doctor/expert: "What kind of future do you think the ADHD Data Bracelet will have? How can it be marketed?".

*"I think it is a great idea and that it can definitely have a positive influence on the child. I think it should mostly be promoted by professionals. For example, when providing parents information after diagnosis. Because correct use of the product is of high importance to prevent negative effects like anxiety due to overuse"*

*"It can be marketed towards psychiatrists, and they would introduce it to the parents"*

*"It is imperative to find an entity to adopt the project and distribute it to a number of patients and read the results later with an explanatory video of the product and how to use it"*

For the last question experts express enthusiasm toward the product and suggested that it should be introduced to parents and people with ADHD by psychologists, psychiatrists, or neurologists, people that know how to treat and deal with the disorder.

## 4.2 Conclusion of the chapter

The research has produced positive results as it has confirmed that the ADHD Data Bracelet App can be an effective product to help those who have ADHD as it allows to address its main problems. Experts have shown enthusiasm for the product stating that its features are suitable and not harmful if used during the day by children and adolescents who have this disorder.

The questionnaire also confirmed that the literature review on which the features of the ADHD Data Bracelet were built was correctly analyzed and understood in the best possible way as it allowed to create a product that can really help and support psychologists, psychiatrists, psychotherapists, etc. in the path they carry out every day with children and adolescents with ADHD.

Most experts would like to try a prototype of the product because, although there are correct theoretical bases, to affirm with certainty its effectiveness it should be tested in order to understand the possible uses and improvements to be made.

The main issues were about the addiction the Bracelet could cause but with testing and the mutual collaboration between experts and parents this problem could be solved, and the perfect formula could be used to not let the children lose its autonomy.

# 5. THE ADHD DATA BRACELET APP

## 5.0 Introduction to the product

This chapter will introduce the ADHD Data Bracelet App its main characteristics and functionalities.

The product presented by this thesis consists of two different products: an application and a bracelet. The app will contain all the features and information about ADHD and will be used mainly by parents, teacher, and psychologists, while the bracelet it will be used mainly by the child and will be the device where all the ADHD features of the app will be displayed.

It is important to point out that all the information contained in the application are from reliable sources as psychologists, psychiatrists, neurologists, and behavioral coaches/experts that have been contacted.

The main objective that the ADHD Data Bracelet App has is that of improving the quality of life of all the children and adolescents that have the disorder, spreading awareness among people that surround them like family members, teachers, and friends.

## 5.1 The product

### *5.1.1 Product description*

**The application**

The application can be downloaded on the child's smartwatch, but also smartphones so that it could be accessed by parents, teachers, and psychologists/therapists.

To ensure privacy the user can have access to the functionalities and information of the app through an account. The account will be shared for a maximum of four people: the child, a parent, a teacher, and the psychologist/therapist.

The parents will have full access to their child's activities and can decide which of those will be shared with the psychologist and teachers.

Parents and teachers can track the child's activities, set reminders, organize and split time for homework and school activities, set the time for a task. If the tasks set for a specific day are completed the child could receive a reward that the parents can develop with the help of experts. All these features will help parents and teachers to better understand children with ADHD, their needs, and main issues.

The app will be also useful for a psychologist that analyzing all the activities registered could be able of diagnosing the disorder more easily.

## 5.2 The problem

ADHD is a neurodevelopmental disorder that causes inattention, or excessive activity and impulsivity in people affected by it. Nowadays, 5- 8% of global children and 4% of the adult population have ADHD. This disorder can cause a sense of inadequacy and discomfort, especially in young people who begin school and approach social activities. Common symptoms include restlessness, difficulty in focusing or staying organized, and impulsivity. Those with an ADHD diagnosis also exhibit difficulty sitting still or engaging in quiet activities. An individual may be diagnosed with one of the three different presentations of ADHD: predominantly inattentive, predominantly hyperactive-impulsive, or a third a combination of both.

A disorder like ADHD can create a feeling of inadequacy in the child, feeling that can get worst if people around the child do not know how to deal with it.

The problem with ADHD is that this disorder is usually misunderstood, and little is known about it, especially by parents and teachers that are the most important characters in children's lives and education.

## 5.3 What problem the product is answering/filling

This product targets some of the struggles that people diagnosed with ADHD face in their daily routine. The ADHD Data Bracelet App tries to educate people on the ADHD topic giving a tool that can spread awareness and improves people's lives.

The product makes children take responsibility for their actions because achieving an objective can guarantee them a reward. This feature of the application will be successful because children can see how they can accomplish things and they know that their actions have consequences. The app will help kids to have a plan and a routine, will train their sense of responsibility, raise awareness of tasks, and overall educate children to always do better.

Self-esteem and confidence will grow in children because they feel that things can be accomplished by just doing them. The rewards are completely adjustable for every user. Some will prefer rewards in the form of food, while for others a movie, tv-series, or games.

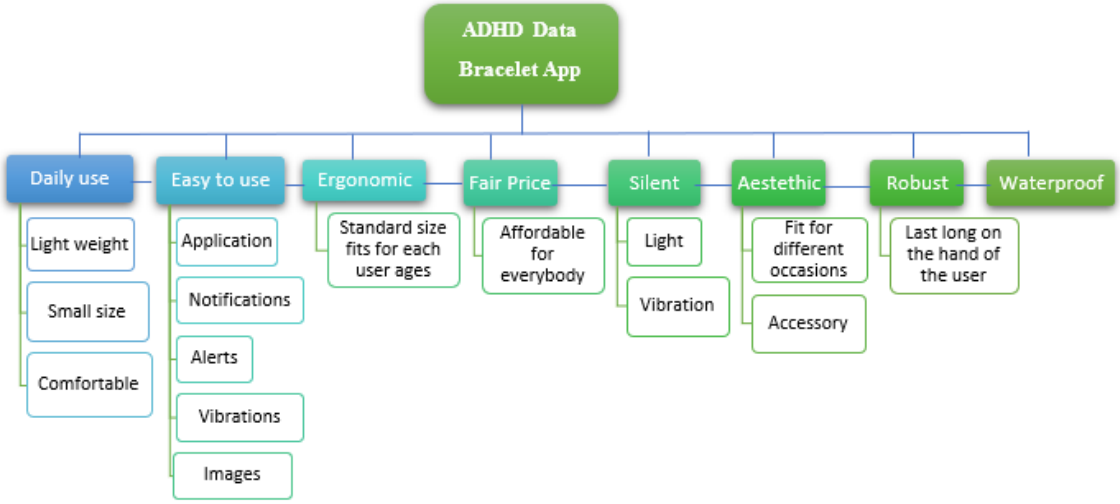
Another aspect of this product is that of making the life of parents and teachers easier, the daily life will be more harmonious and less stressful for everybody. An example is that parents will not be forced to always repeat themselves with their children because the application will do that through the notification system so that parents are less stressed and children less annoyed by parents losing their patience or always repeating themselves.

The app will also help children with ADHD to be more aware of themselves and their surroundings because the app will link them to their families and teacher allowing them to share their struggles and difficulties. Parents and teachers on the other side will be more conscious of what a child with ADHD has to face and will know better how to behave to provide the right support.

The app will be helpful to doctors too because will clarify if the child has a mild, intermediate, or severe ADHD based on how easily he or she will complete the task and achieve goals set by parents and teachers.

## 5.4 Functional requirements- ADHD Data Bracelet App

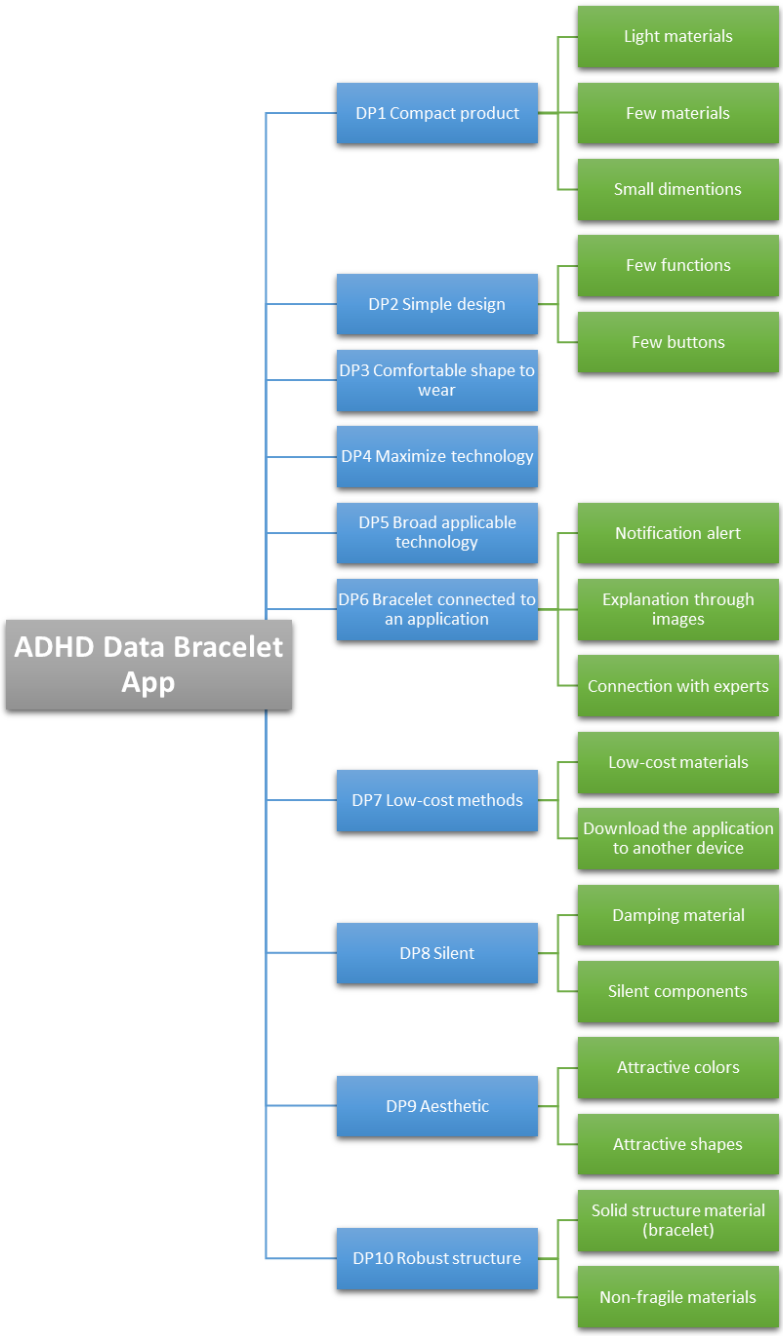
*Figure 1-Functional requirements*




It is important to underline the fact that the application for this thesis is used through a specific bracelet, but it can be downloaded also on other devices like smartphones and tablets.

## 5.5 Design Parameters- ADHD Data Bracelet App

*Figure 2-Design parameters*




This chapter will show the evolution of the product. There were a lot of design challenges during this project, the design of the watch has been changed multiple times while maintaining the main feature. 3D renderings are shown to guide the viewer through the developing process.

The product is described, and the functioning is explained through a 3D CAD model rendering that aims to give the reader an idea of how the product will look in real life. The CAD used to realize the 3Ds was Autodesk Inventor.

*Figure 3- ADHD Data Bracelet 3D n°1*

*Figure 4- ADHD Data Bracelet 3D n°2*

The ADHD Data Bracelet App is a smartwatch that works thanks to an application managed remotely by parents. The application can be downloaded on a tablet or a smartphone and can be accessed via a code that will create a connection with the bracelet via Bluetooth.

From a technological point of view, the product is composed of:

- Set of sensors (motion sensors, biosensors, and environmental sensors) to detect the heartbeat, movement, and temperature,
- Wireless chips that allow Bluetooth connection and Wi-Fi connection,
- A rechargeable lithium battery that allows the product to have a longer life without losing charge too quickly,
- Processor (Advanced RISC Machines ARM).

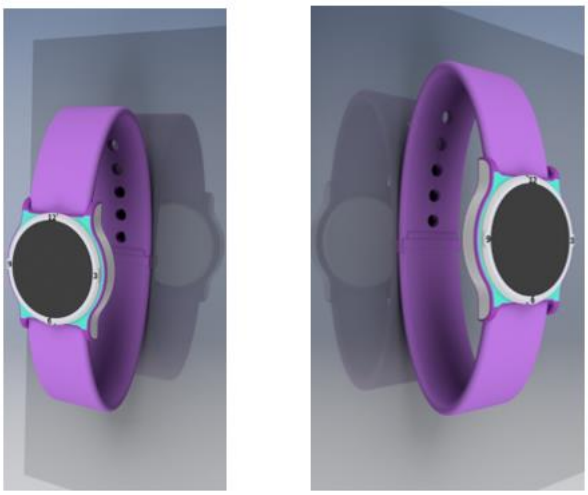


*Figure 5- ADHD Data Bracelet 3D n°3*

### *5.5.1 Components*

The product is composed of a bracelet and an application connected to it. The bracelet is made with a silicon cover and a core part that contains all the electronic elements of the bracelet.

At the heart of a wearable product such as a smartwatch, there is a Printed Circuit Board (PCB) that is used to mechanically support and electrically connect electronic components using conductive pathways[7].

In the construction of a PCB, the choice of materials is fundamental to guarantee a product that is as efficient as possible. It must be considered that smartwatches require a high degree of reliability and must often handle high speed and high-frequency signals. The cheapest choice is that of the FR4. But when handling high-frequency signals, it is necessary to limit the power losses and therefore a material like Rogers 4350 is preferable. Since FR4 has a higher dissipation factor (Df) than Rogers materials, especially at high frequencies, and FR4 laminate with high-frequency signals creates insertion losses of a not negligible value, thus reducing the power and transmission capacity of electrical signals. A PCB made with Rogers laminates offers superior performance and reliability over the traditional FR4, at an overall acceptable cost.[8]

[7] https://www.eurocircuits.com/pcb-printed-circuit-board/
[8] https://www.proto-electronics.com/blog/wearable-pcb-design-guidelines

Considering the above the PCB used for ADHD Data Bracelet App should be able to guarantee the best performance possible considering all the functions of the Bracelet so the best material will be Rogers.

Considering the daily and assiduous use of the product, it is advisable to opt for a 160 mAh Li-Po (lithium polymer) battery that will easily be able to power the watch with regular use for at least a week. For the battery, a USB charging module will be used to charge the battery.

The electronic elements used were:

- USB Interface,
- A real-time clock module,
- A Battery charging module,
- An accelerometer Module to track movements and physical activity,
- An SMD resistor that offers advantages in saving space on the PCBs,
- A Pulse sensor to measure heartbeat,
- A USB-TTL module to convert TTL signal a USB interface,
- OLED Display,
- A Bluetooth module.

As shown in the figure, the smartwatch is made using a silicone strap that covers the product to protect it from impact, the heart of the smartwatch equipped with a touchscreen can be inserted inside the silicone sheath.

*Figure 6- ADHD Data Bracelet 3D n°4*

### *5.5.2 Ergonomics*

Ergonomics is the interaction of humans and products. An ergonomic shape of a product decreases any possible injury. For the product that is being designed the ergonomic data of wrist sizes are necessary.

Ergonomically we can say that a smartwatch is worn on the body and emotionally is considered decorative, an accessory with the characteristic of being always on.

A smartwatch is different from a smartphone because is worn but, even if it does not have to be retrieved from a pocket or bag this does not mean it is easier to use: a child or an adolescent using a smartwatch have to lift their arm and rotate their wrist just to view the watch. This is not a difficult gesture but can be annoying and uncomfortable to do repetitively.

A smartwatch being a wearable device is always in direct contact with the skin, and for this reason, tactile feedbacks are just as important, and in some cases, more important than visual display.[9]

Because a wearable device should be used while the person is in motion, every day and 24 hours a day it becomes an integral part of the person's clothing, it should be lightweight, beautiful, shape-conformable, multi-functional, and easily configurable.

The customers of the ADHD Data Bracelet App are children and adolescents that go to school and have a life characterized by multiple social activities.

To design the smartwatch that is worn on the wrist it was essential to understand the average size of the target: boys and girls from 6 to 17 years old.

The table below represents the average wrist size, and we can notice that the difference between boys and girls is not that significant from 6 to 14 and is usually about 1 cm, it increases from 15 to 17 years old where the difference in the wrist circumference is about 2 cm.

[9] https://www.fastcompany.com/3022457/5-surprising-principles-for-designing-smartwatches

| Age (years) | | Percentiles | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3rd | 5th | 10th | 15th | 25th | 50th | 75th | 85th | 90th | 95th | 97th |
| **Boys** | **n** | | | | | | | | | | | |
| 6 | 127 | 11.47 | 11.60 | 11.82 | 11.99 | 12.27 | 12.92 | 13.65 | 14.01 | 14.23 | 14.56 | 14.75 |
| 7 | 174 | 11.70 | 11.84 | 12.06 | 12.23 | 12.52 | 13.18 | 13.91 | 14.27 | 14.50 | 14.82 | 15.02 |
| 8 | | 11.99 | 12.12 | 12.36 | 12.53 | 12.83 | 13.50 | 14.23 | 14.59 | 14.82 | 15.14 | 15.34 |
| 185 | | | | | | | | | | | | |
| 9 | 156 | 12.31 | 12.46 | 12.70 | 12.88 | 13.19 | 13.86 | 14.59 | 14.95 | 15.18 | 15.51 | 15.71 |
| 10 | 179 | 12.67 | 12.83 | 13.08 | 13.27 | 13.58 | 14.27 | 15.00 | 15.36 | 15.59 | 15.92 | 16.12 |
| 11 | 168 | 13.05 | 13.21 | 13.48 | 13.68 | 14.00 | 14.69 | 15.42 | 15.78 | 16.01 | 16.34 | 16.55 |
| 12 | 126 | 13.42 | 13.59 | 13.88 | 14.08 | 14.41 | 15.11 | 15.83 | 16.19 | 16.43 | 16.76 | 16.97 |
| 13 | 139 | 13.79 | 13.98 | 14.28 | 14.50 | 14.84 | 15.54 | 16.26 | 16.62 | 16.86 | 17.20 | 17.42 |
| 14 | 153 | 14.19 | 14.39 | 14.71 | 14.94 | 15.29 | 15.99 | 16.70 | 17.08 | 17.32 | 17.68 | 17.91 |
| 15 | 223 | 14.55 | 14.76 | 15.10 | 15.34 | 15.69 | 16.39 | 17.11 | 17.50 | 17.76 | 18.15 | 18.40 |
| 16 | 217 | 14.80 | 15.03 | 15.38 | 15.63 | 15.99 | 16.69 | 17.41 | 17.82 | 18.11 | 18.54 | 18.83 |
| 17 | 84 | 14.92 | 15.16 | 15.54 | 15.79 | 16.16 | 16.85 | 17.58 | 18.02 | 18.33 | 18.83 | 19.17 |
| **Girls** | **n** | | | | | | | | | | | |
| 6 | 135 | 10.70 | 10.87 | 11.16 | 11.37 | 11.70 | 12.41 | 13.08 | 13.37 | 13.55 | 13.78 | 13.91 |
| 7 | 175 | 11.09 | 11.26 | 11.55 | 11.76 | 12.09 | 12.80 | 13.48 | 13.78 | 13.96 | 14.21 | 14.35 |
| 8 | 191 | 11.51 | 11.68 | 11.97 | 12.17 | 12.51 | 13.21 | 13.89 | 14.21 | 14.40 | 14.66 | 14.81 |
| 9 | 162 | 11.92 | 12.09 | 12.38 | 12.58 | 12.91 | 13.60 | 14.29 | 14.62 | 14.82 | 15.10 | 15.27 |
| 10 | 193 | 12.35 | 12.52 | 12.80 | 13.01 | 13.33 | 14.02 | 14.72 | 15.05 | 15.26 | 15.56 | 15.74 |
| 11 | 136 | 12.81 | 12.98 | 13.26 | 13.46 | 13.78 | 14.46 | 15.15 | 15.50 | 15.72 | 16.04 | 16.23 |
| 12 | 165 | 13.21 | 13.38 | 13.65 | 13.84 | 14.16 | 14.82 | 15.51 | 15.86 | 16.09 | 16.42 | 16.62 |
| 13 | 167 | 13.53 | 13.69 | 13.96 | 14.15 | 14.45 | 15.10 | 15.78 | 16.13 | 16.36 | 16.69 | 16.90 |
| 14 | 150 | 13.80 | 13.95 | 14.21 | 14.39 | 14.69 | 15.32 | 15.99 | 16.33 | 16.56 | 16.88 | 17.09 |
| 15 | 379 | 13.97 | 14.12 | 14.36 | 14.54 | 14.83 | 15.44 | 16.09 | 16.43 | 16.64 | 16.96 | 17.15 |
| 16 | 413 | 14.04 | 14.18 | 14.43 | 14.60 | 14.89 | 15.49 | 16.12 | 16.43 | 16.64 | 16.96 | 17.15 |
| 17 | 133 | 14.09 | 14.24 | 14.49 | 14.67 | 14.95 | 15.54 | 16.15 | 16.46 | 16.65 | 16.96 | 17.15 |

Age indicates whole age group (e.g. 7.00-7.99 years, etc.)

*Figure 7-Age related wrist circumference*[10]

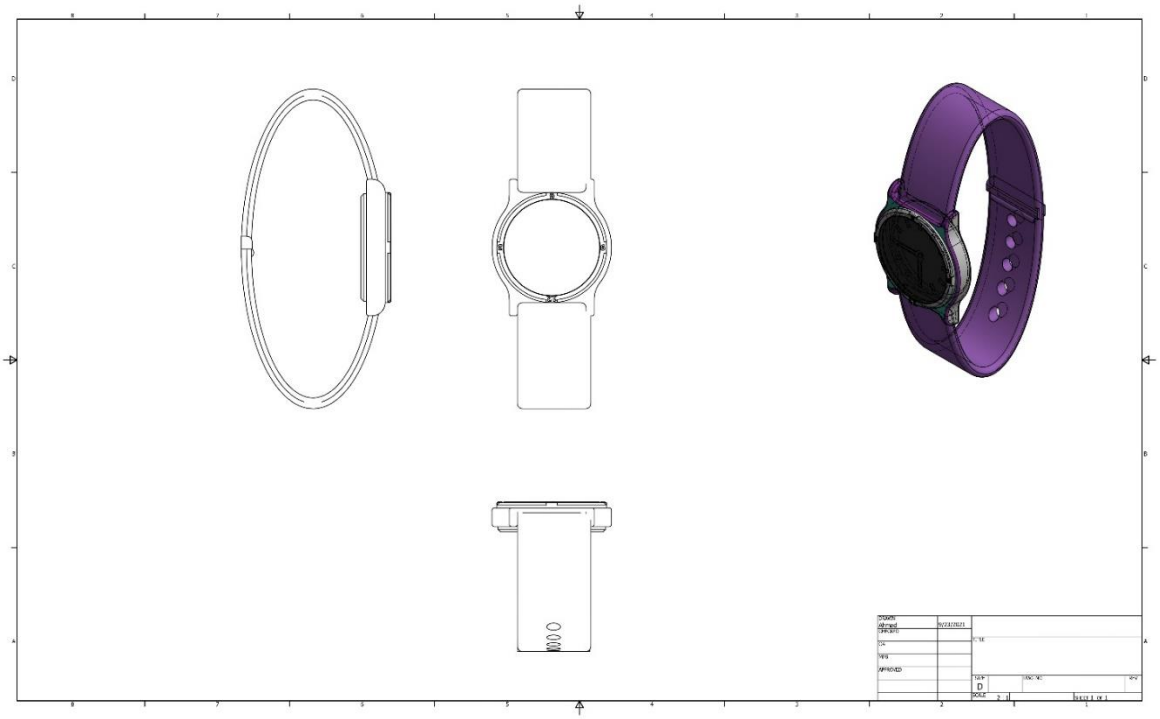


*Figure 8-Technical Drawings*

[10] https://www.researchgate.net/figure/Age-related-wrist-circumference-cm-percentiles-of-6-17-year-old-Turkish-boys-and-girls_tbl1_317015630

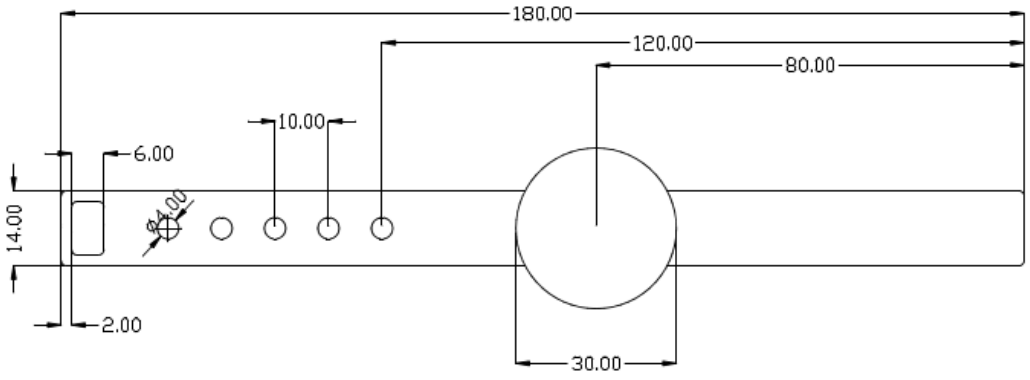



*Figure 9-ADHD Data Bracelet App measurements*

### *5.5.3 Materials*

Silicone is an inorganic product and one of its main characteristics is a minimum duration of 10 years.

Some of its properties are that of being water retention, being soft and soft touch to fabrics, being stable at high temperatures, and having a high lubrication. Silicones are ideal for manufacturing products that generate comfort and safety for people.

Silicones can be considered semi-organic compounds because they have a silicon atom in the middle of their main chain, which is usually combined with an oxygen atom. Silicones are chemically inert polymers, resistant to decomposition by heat, water, or oxidizing agents, and are good electrical insulators. Being inert does not harm the environment, so it does not contaminate the soil, water, or air.

Silicone can be handled safely without risk to human health. In addition, most silicones are recyclable, so they do not pollute the environment.[11]

The silicone does not stick to the hair, and this is a very important factor considering that will be always worn by children that might take shower and sleep with it.

[11] https://en.wikipedia.org/wiki/Silicone_rubber

*Figure 10- ADHD Data Bracelet 3D n°5*

As shown in the figure, the silicone wraps the smartwatch completely to protect it from possible bumps and falls taking into account the fact that children or adolescents could wear it during games and sports activities.

The glass covering the watch could be acrylic glass that is cheap, transparent, flexible, and impact-resistant, even if is not scratch resistant a scratch on acrylic glass is easy to repair. [12]

### *5.5.4 Manufacturing process- Liquid Silicone Rubber Molding*

Because of the thermosetting nature of the material, injection molding liquid silicone rubber necessitates unique considerations, such as homogeneous distributive mixing; in addition, the material must be kept at a steady temperature until pushed into the heated cavity and vulcanized.

LSRs are available in pail or drum kits. These rubbers can be pumped through hoses and pipelines to the injection equipment because of their low viscosity. A kit is made up of two independent components (labeled A and B in the diagram), which are pumped through a static mixer by a metering pump. The platinum-based catalyst is found in one of the components. Before the material goes into the static mixer, you can add a coloring paste and other ingredients. The components are thoroughly mixed in the static mixer before being

[12] https://www.benswatchclub.com/blog/types-of-watch-glass

delivered to the cooled metering portion of the liquid silicone rubber machine's injection molding.[13]

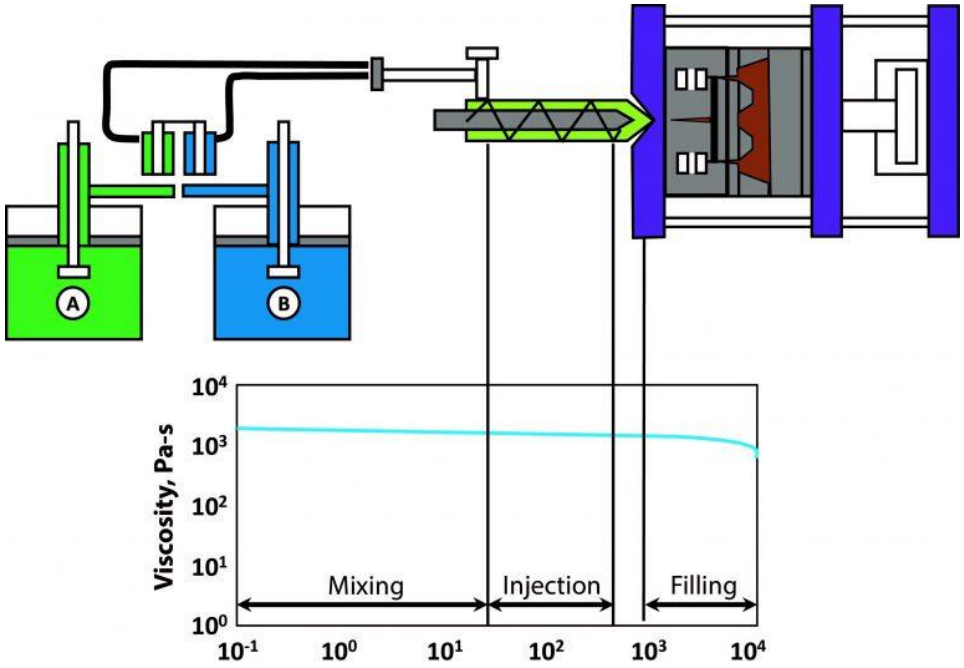



*Figure 11- Injection molding optical liquid silicone*[14]

The static mixer's job is to mix all three entering ingredients, component A, component B, and a pigment, uniformly. This mixing procedure assures uniform material dosage and starts the vulcanization process a fraction of a second before the raw ingredients are injected. This method is quite precise, especially when compared to HCR. HCR materials are typically sold in the form of compounds, which are pre-mixed and partially vulcanized. The compound is pumped through numerous cold runner systems from the injection molding machine's metering section into a heated cavity where the vulcanization takes place. Material waste is eliminated with the cold runner technology. Cooling the material allows for the fabrication of LSR components with almost no material loss, obviating the need for trimming and resulting in significant material cost savings – all while generating a flash-free part – provided a high-precision, high-quality tool is used.

LSR's exceptional adherence to plastics and metals makes it the ideal material for liquid silicone rubber technology's two-shot and over-molding injection molding, also known as multi-shot or assembly injection molding.

[13] https://www.simtec-silicone.com/why-making-parts-from-lsr-is-the-only-option/
[14] *rubberhttps://www.simtec-silicone.com/injection-molding-optical-liquid-silicone-rubber/*

Two-shot injection molding of liquid silicone rubber allows for the direct mixing of two materials – one with a cold runner and the other with a hot runner – in the same injection mold, saving time and money while allowing for the integration of multiple functional features in one ejected, finished part; this process ensures consistency and ensures that every cog is the same size.[15]

There are 7 benefits from the liquid injection molding process:

1. Shorter cure time than compression and transfer molding.
2. Ideal for intricate designs, high precision, and close tolerance parts.
3. Automation increases the cost-effectiveness and may decrease the run time.
4. Suitable for mass production.
5. Fast cure time.
6. It is recommended to use an automated process for high production runs, while low production runs are best using manual process.
7. Thermal imaging technology may be used to identify potential production errors such as molding flaws or design problems.[16]

## 5.6 Product's features

### App feature's description

The application has eight main features that target the most critical issues of ADHD. The features have been developed after careful studies and research about ADHD and after consultations with doctors and ADHD experts.

**Emoji:** As explained widely in the first chapter, children with ADHD has more difficulty in managing and controlling their emotions and to give support to this issue the ADHD Data Bracelet App will use the emoji feature. Emojis are small digital images used to describe an emotion or an idea. The Bracelet will use emojis to explain to children their emotions, their characteristics, and the reason why they feel in a certain way when they are angry, sad, happy, scared, etc. The app will show the emojis and parents will explain them to the child. The purpose of this feature is to introduce children to emotions, to improve their self-control and anger management issues.

[15] https://www.simtec-silicone.com/why-making-parts-from-lsr-is-the-only-option/
[16] https://siliconedynamics.net/fabrication-methods-for-silicone-rubber/

**Time of activity:** Time of activity is a feature that targets attention, distraction, and difficulties to use what is learned. The main objective of this feature is to avoid the child doing activities that requires a long time where he/she must be sat for too long without moving. The feature will give to the parents the opportunity to program the activities and task the child must accomplish during the day suggesting programming short and engaging activities instead of long and boring ones.

**Splitting task:** Keeping attention, distraction, self-control, and difficulties to use what learned are the issues targeted by the splitting task feature. When a task is too long or "boring" children with ADHD tend to give up on distraction, in this way can be more difficult to achieve objectives like studying for a math test or finishing the homework for a subject. The splitting task feature will split an activity into shorter phases divided by breaks that will allow children or teenagers to successfully finish it. For example, if the child has to do homework for the next day it will be useless to force him/her to sit still on a desk for an hour or two, it will be more effective to divide the time for homework into smaller part setting a timer every twenty minutes to let the child having a break that can be a game, a funny video or a walk that will allow him/her to move and be more focused when it is time to go back on homework.

**Reward:** This feature treats attention, distraction, self-control, and difficulties to use what is learned. A child with ADHD needs the motivation to stay focused and to achieve objectives, so giving he/her a reward is a good motivation to do homework or study. Through this function of the ADHD Data Bracelet App, parents can program each day the activity their child has to accomplish, and at the end of the day, they can check which of these tasks have been completed and which have not. If the child completed all or most of the tasks, they could give him/her a reward that will be a motivation to do better the next day.

**Info for parents and teachers and connection with professionals:** These two features can be considered as the most important features of the ADHD Data Bracelet App because are a direct link between parents, teachers, and doctor/experts of ADHD. These features have an educational purpose for those who are close to someone with ADHD and offer them a strong tool to help their loved ones thanks to professional support. Parents and teachers can ask for information about ADHD from experts that will guide them towards the best way of helping those with the disorder, spreading awareness, and fighting misunderstandings and

misconceptions. These features also offer the possibility for parents and teachers to exchange information through a forum section.

**Achievement reminders:** Attention, distraction, and difficulties to use what learned are the ADHD issues targeted by the achievements' reminders feature. This feature will allow parents to set a reminder (vibrating pulse) that will "remind" the child or teenager of the activity he/she must do at that time of the day.

**Breathing exercises:** The breathing exercises feature will help those with ADHD managing with their emotions, will improve their self-control, and anger management. Parents can set the time when notification will be sent to the child or teenager to remind him/her of their daily breathing exercises. Breathing exercises can be also used between a task and another, like a break from study or to calm down after an anger episode, they will make the children relax and will make them more aware of themselves and is a reminder that they are in control of their body, breath, and emotions.

*Table 2-Product features, own source*

| | Emotion | Attention | Distraction | Self-control | Anger management | Difficulties to use what learned |
|---|---|---|---|---|---|---|
| **Emoji** | X | | | X | X | |
| **Splitting tasks** | | X | X | X | | X |
| **Time of activity** | | X | X | | | X |
| **Reward** | | X | X | X | | X |
| **Info for parents and teachers** | X | X | X | X | X | X |
| **Connection with professionals** | X | X | X | X | X | X |
| **Achievement reminders** | | X | X | | | X |
| **Breathing exercises** | X | | | X | X | |


*Figure 12- App Logo*

These features were developed after a deep analysis of the literature exposed in the second chapter. At this point, it was necessary to understand if the features would be effective to address ADHD and if experts that deal with the disorder every day would give the product a try.

To do that a questionnaire was developed and submitted to ADHD expert that, through 16 questions, had to express their thoughts and evaluation about the product. The results of the questionnaire will be explained in the fifth chapter.

# 6. STRATEGIC MARKETING PLAN

## 6.0 Introduction to the chapter

The goal of this chapter is to make a detailed marketing plan for launching the ADHD Data Bracelet App. To do this it is important to understand the necessity of a strategic plan, all its phases, with the PESTAI, the market analysis, the consumer analysis, and the competitors' analysis.

## 6.1 European PESTAI analysis for ADHD Data Bracelet App

In this thesis, the PESTAI was grossed with the threats and opportunities connected to the SWOT analysis to better understand the European scenario and what means to develop a product in this continent ruled by communitarian laws and regulations.

### *6.1.1 Political factors*

The main political factors to take into account are five. The first one is the CE stamp that can be a threat to the ADHD Data Bracelet App, as explained on the EU site before they can be sold in the EU, many items need CE labeling. The CE marking means that a product has been assessed by the manufacturer and is considered to comply with the requirements of the EU in terms of safety, health, and environmental protection. Items produced anywhere in the world that are then sold in the EU need this. CE marking is only compulsory for items for which there are EU requirements, and which require CE marking to be affixed. Some goods are, at the same time, subject to many EU specifications. Before affixing the CE marking to it, you must make sure that your product complies with all the applicable specifications. Items for which EU requirements do not exist or do not require the affixation of a CE marking are prohibited from affixing the CE marking. Obtaining the stamp can be a long and expensive process so this factor can be considered a threat.

The EU regulation 2017/745 (Regulation (EU) 2017/745), can also be a threat because of a regulation that imposes rules and standards to a device that is classified as medical devices. The regulation says “Council Directive 90/385/EEC (3) and Council Directive 93/42/EEC (4) constitute the Union regulatory framework for medical devices, other than in vitro diagnostic medical devices. However, a fundamental revision of those Directives is needed to establish a robust, transparent, predictable, and sustainable regulatory framework for medical devices which ensures a high level of safety and health whilst supporting innovation.” This factor can be negative because the ADHD Data Bracelet App may require

following specific rules and regulations to realize the bracelet that will be used as a therapy for a disorder recognized as a mental health issue.

The rise of a European Consensus Statement on diagnosis and treatment of adult ADHD is an opportunity among the political factors because it has consequently developed a standard way to treat ADHD, reducing the margin of error in producing and developing a product that will treat a mental health issue.

The Consumer Rights Directive gives the same strong EU-wide rights to customers. It harmonizes national market laws, such as the need to provide customers with details before they buy something, and their right to cancel online transactions anywhere they shop in the EU. As imposed by this law the product should respect some norms when it is sold in all the European Union that add more rules to follow not only during the product production but also during the product commercialization.

The rising of EU ADHD institutions can be seen as a good opportunity to highlight[17] the ADHD disorder and treatments official institutions can bring more awareness of ADHD and represent an official voice for those that have been diagnosed with the disorder.

Finally, the presence of strict regulatory guidelines and the high cost of medications are expected to restrain the growth of the ADHD therapeutics market in Europe and be a threat to the development of a product related to it.

### *6.1.2 Economic factors*

Among the opportunities of the economic factors, there is the market value of global attention deficit hyperactivity disorder therapeutics is expected to hit USD 17.5 billion by 2025[18]. The market is rising at a CAGR of 9.09 percent over this period. Moreover, the market in Europe is predicted to worth USD 4.3 billion by 2024 from USD 2.93 billion in 2019. [19]

[17] https://add.org/start/adda-resources/

[18] https://www.grandviewresearch.com/industry-analysis/attention-deficit-hyperactivity-disorder-adhd-market https://www.marketdataforecast.com/market-reports/attention-deficit-hyperactivity-disorder-therapeutics-market

[19] https://www.grandviewresearch.com/industry-analysis/attention-deficit-hyperactivity-disorder-adhd-market https://www.marketdataforecast.com/market-reports/attention-deficit-hyperactivity-disorder-therapeutics-market

Another opportunity that can drive parents to buy the device is the high cost of medications, so to reduce the amount of money invested in medication they could be willing to try new and different alternatives like the ADHD Data Bracelet App.

The economic factor that can be considered as a threat is the Covid-19 economic consequences that could slow down the growth of the ADHD treatments market.

### *6.1.3 Social factors*

Among the social factors as opportunities there is an increased awareness for the ADHD[20] disorder, the fact that behavioral therapies are the most chose by therapists and families, and finally, an increasing involvement from public organizations. All these positive factors will help to spread knowledge and awareness towards the disorder and favors a proactive social change towards those who have ADHD who are no longer seen as outsiders but are understood and inserted within social contexts most naturally and comprehensively possible.

The only threat in the social factors is the psychological negative impact of COVID-19. COVID-19 has had several adverse effects on persons with attention-deficitt hyperactivity disorder. The primary explanation for the impact is the exposure to the pandemic and physical distance measures triggered by the anxiety. The patient may display a rise in behavioral concerns due to these factors.

### *6.1.4 Technological factors*

The technological factor presents several opportunities like ever-increasing research and development in the field of scientific research that will also increase the knowledge on the technical aspect in the realization of the product; exponential advancement in the research and innovation of mobile app and device technologies and the growth of attention and awareness towards ADHD increases investments in the research of medical and non-medical therapies.

The main threat, in this case, is having more and more developed technologies within everyone's reach with a consequent growth of computer operators who offer more and more electronic products for the market of the treatment of ADHD, which previously could be considered a blue ocean.

[20] https://psychiatry.arizona.edu/blog-post/raising-adhd-awareness

### *6.1.5 Environmental factors*

The main opportunity is given by the possibility of using recyclable materials in the production of the Bracelet due to the development in this field and the realization of ecofriendly materials. Another opportunity is given by the fact that even if the Bracelet and the App will be presented as one product, the app can be installed in an existing device avoiding unnecessary waste and limit the damages to the environments

Threats are the European high costs for material and production and the growing attention towards the environmental problem that is causing the birth of new environmental restrictive rules.

### *6.1.6 International factors*

North America has the highest share of 36% of the global therapeutics market, considering the rising growth rate in the global percentage of people with ADHD disorder. The European market has the second-highest share of the global therapeutics market, so there is the possibility to export to foreign countries to have bigger markets to create bigger income. The only threat is the possibility of a ban on imports and export in some countries as well as duties and taxes for imported products.

*Table 3-PESTAI ANALYSIS*[21]

| | | **O** | **T** |
|---|---|---|---|
| *Political factors* | cє Stamp | | X |
| | EU regulation 2017/745 (Regulation (EU) 2017/745) | | X |
| | European Consensus Statement on diagnosis and treatment of adult ADHD | X | |
| | Customer protection law | | X |
| | EU ADHD rising institutions | X | |
| | The presence of strict regulatory guidelines and the high cost of medications are expected to restrain the growth of the ADHD therapeutics market in Europe | | X |
| | CAGR 8.10% from 2019 to 2024 | X | |
| | The market in Europe is predicted to worth USD 4.3 billion by 2024 from USD 2.93 billion in 2019 | X | |

[21] https://www.grandviewresearch.com/industry-analysis/attention-deficit-hyperactivity-disorder-adhd-market https://www.marketdataforecast.com/market-reports/attention-deficit-hyperactivity-disorder-therapeutics-market

| | | | |
|---|---|---|---|
| *Economic factors* | High cost for medications and threatens | X | |
| | Improper reimbursement policies | | X |
| | Covid-19 economic consequences | | X |
| *Social factors* | Increased awareness for the ADHD disorder | X | |
| | The psychological negative impact of COVID-19 | | X |
| | Behavioral therapy is the most chose by therapists and families | X | |
| | Increasing involvement from public organizations | X | |
| *Technological factors* | Ever-increasing research and development in the field of scientific research | X | |
| | Exponential advancement in the research and innovation of mobile app and device technologies | X | |
| | Growth of attention and awareness towards ADHD increases investments in the research of medical and non-medical therapies | X | |
| | Increasing competitors | | X |
| *Environmental factors* | Recyclable product and materials | X | |
| | An app that can be installed on other devices | X | |
| | High material and productions costs | X | |
| | New environmental restrictive rules | | X |
| *International factors* | North America has the highest share of 36% of the global therapeutics market | | X |
| | The rising growth rate in the global percentage of people with ADHD disorder | X | |
| | The European market has the second-highest share of the global therapeutics market | X | |
| | Export to foreign countries to have bigger markets | X | |
| | Ban on import and export | | X |

## 6.2 Market analysis, size of the market, potential costumers

The attractiveness and dynamics of a special sector within a special industry are investigated in a market study.

According to what said before, in the business research there are certain fundamental elements to be considered: the market size (current and future), the market trends, the market growth rate, the market profitability, the industry cost structure, the distribution channels, the key success factors, and the key success details.

Market research attempts to assess a market's attractiveness, both now and in the future. Organizations assess a market's potential attractiveness by recognizing emerging opportunities and challenges as they relate to the strengths and weaknesses of that company/product.[22]

To understand the growth of the ADHD market in Europe it is essential to compare it with the global market especially with the American one.

Awareness of ADHD in Europe was uneven in the 1990s and 2000s and the stigma was strong. ADHD was frequently rejected as an American medical fad.

At the time, in the United States, strong advocacy organizations and bestselling books had increased awareness of ADHD. The Individuals with Disabilities Act (IDEA) of 1990 required American public schools to grant fair access and offer additional school accommodation to students with ADHD. Most of the initial study on ADHD was led by American scientists and physicians. With the wider standards set by the American Psychiatric Association, U.S. physicians have diagnosed ADHD.

Meanwhile, the Member States of EU have used a patchwork of various national standards or guidelines from the World Health Organization. Doctors have had little clinical experience using these guidelines in several European countries.[23]

The diversity of ADHD is clear all around the world: attention-deficit/hyperactivity disorder, although the signs are the same, sounds slightly different depending on where you live. Here's a sample:

- In France is Trouble du déficit de l'attention avec ou sans hyperactivité (TDAH),
- In Germany is Das Aufmerksamkeitsdefizitsyndrom ohne Hyperaktivität (ADHS),
- In Denmark is ADHD/Hyperkinetiske forstyrrelser,
- In Russia, there is no name to describe the disorder,
- In Portugal is Transtorno do Déficit de Atenção e Hiperatividade (TDAH).

European attitudes towards ADHD are dramatically shifting. At least 3.3 million children (1 in 20) in the European Union are now projected to have ADHD by European agencies. The health, education, and justice system costs of keeping ADHD untreated are quantified by

[22] "Market Analysis". NeMBA. Retrieved 3 August 2012.

[23] https://www.additudemag.com/is-europe-doing-a-better-job-of-treating-adhd-than-the-u-s/

European agencies. European doctors and scientists gradually lead multinational ADHD organizations, such as the World Federation Congress. Several committees discussed cutting-edge studies in the detection and care of ADHD at its fifth meeting in Scotland in May 2015. In July 2015, through its unified authorization process for drug approval, the EU authorized the first ADHD therapeutic product, an alternative to stimulant medicine.

As a Europe-wide lobbying body, ADHD Europe has arisen. In each of the 28 EU Member States, ADHD parent support, and Facebook groups now exist.

The dedication of the proponents of European ADHD is remarkable. Since 2009, Hyper supers, a network of French parents and adults dealing with ADHD, has been working to enable the French medical system to participate actively in the treatment of ADHD. The French Haute Autorité de Santé (HAS), a major ADHD skeptic, eventually accepted in March 2015 that inattentive ADHD is a genuine subtype of the condition.

Europe-wide policies to combat ADHD are now beginning to emerge. In 2007, a declaration was adopted by the European Parliament calling on EU institutions and decision-makers to commit more time and energy to ADHD. The Mental Wellbeing, Welfare, and Brain Diseases Interest Group are working to ensure that ADHD stays on the health agenda of the EU.

European states are urged to use a holistic approach as "a last resort measure" for the treatment of ADHD-behavioral coping skills, academic assistance, psychological support, and medication. The Council resolution aims to provide regional coherence to previously decentralized ADHD policies centered in countries.

Any positive signs are there. The European Parliament is recommending that parents raising children with ADHD get more support. The National Institute for Health and Care Quality of the United Kingdom (NICE) already provides behavioral intervention preparation for parents or guardians to improve their ability to support their child with ADHD as part of medical treatment for ADHD. Likewise, the German authorities ensure that pediatric hospitals and special education centers provide specialized ADHD training for parents.

### *6.2.1 Market size*

177.3 million cases of attention deficit hyperactivity disorder (ADHD) were prevalent in people aged 5-44 years worldwide in 2017, and that figure is expected to rise to 187.4 million prevalent cases by 2026. In the number of ADHD clinical trials worldwide, the US has a

significant lead. Germany is at the center of the big EU economies, with Japan at the top in Asia.[24]

According to research and consultancy company Global Data, the demand for attention deficit hyperactivity disorder (ADHD) in the seven main markets (7MM) of the United States, France, Germany, Italy, Spain, the United Kingdom, and Japan is expected to rise from approximately $6.1 billion in 2014 to $13.9 billion by 2024, at a compound annual growth rate of 8.5 percent.

The ADHD industry is currently fighting with unmet needs. This includes the need for more therapeutic choices, head-to-head scientifically meaningful comparisons between existing marketed and pipeline products, better screening testing, and expanded ADHD knowledge and awareness. Global Data expects that both new and existing medications that resolve other unmet needs in this field, which include enhanced diagnosis rates and eventual patient penetration across the 7MM, would quickly open to the ADHD market.[25]

### *6.2.2 Market worth*

In 2018, the global attention deficit hyperactivity disorder industry size was measured at USD 16.4 billion and over the projected period it is expected to show a CAGR of 6.4%. The demand is expected to be powered by-product releases around the globe, legalization of new medicines, and expanded research and development activities.

The ADHD industry is projected to be fuel by a rise in understanding of mental health among the general public and governments. The increasing number of individuals suffering from a variety of mental health problems has caught the attention of policymakers around the world, including attention-deficit/hyperactivity disorder, prompting them to take necessary steps to remedy this disease. The U.S. in 2016 For the next four years, the Health & Human Services Department has awarded up to USD 54 million to the Drug Abuse and Mental Health Services

The attention-deficit/hyperactivity disorder (ADHD) market has been bifurcated into children (ages 2-17) and adults dependent on demographics (aged 18 and above). In 2018, the adult group had the highest market share, and this can be due to a large population of

[24]https://www.globenewswire.com/news-release/2020/03/06/1996456/0/en/Attention-Deficit-Hyperactivity-Disorder-ADHD-Market-Spotlight-Comprising-Key-Marketed-and-Pipeline-Drugs-Clinical-Trials-and-Recent-Events.html
[25] https://www.europeanpharmaceuticalreview.com/news/43874/adhd-market-drugs-improve/

patients. About 4.0% of the adult population of the U.S. were affected by attention-deficit/hyperactivity disorder, according to ADD Health and Wellbeing Centers, Inc. In 2015, the Department of Drug Abuse and Mental Health Services (SAMHSA) saw 17.2 million people using stimulants, of which 1.8 million were young people (ages 12-17) and 4.9 million were adults (age 18-25).[26]

## 6.3 Competition

There is a need to find out everything practicable about rivals to prepare successful strategic marketing campaigns. A frequent comparison between the ADHD Data Bracelet App and goods, costs, platforms, and the promotion of close competitors would be included in this thesis. This comparison will lead to the exploration of fields of possible comparative gain and disadvantage (Kotler et al., 1999).

The ADHD Data Bracelet App would face direct rivals, including most app makers, but even indirect competitors that realize rehabilitation products or behavioral and psychological treatment.

### *6.3.1 Direct Competitors*

According to the websites HealthLine.com, FriendshipCircle.org, and understood.com, the following are the 2020 most efficient and useful apps for those diagnosed with ADHD.

***DUE – REMINDERS & TIMERS***

**iPhone rating**: 4.7 stars

**Price**: $6.99 with in-app purchases

**Description:** Distractibility plays a large part in ADHD, but with reminders to do the important stuff, Due will bring you back on track. Increase your productivity, like taking drugs, by taking the variability out of the must-dos. It is quick to add a reminder, and the software interface is super clean and elegant. It proceeds to buzz you at set intervals when a reminder goes off (say, every 10 minutes) before you mark the task as completed.

***EVERNOTE***

**iPhone rating**: 4.4 stars

[26] https://www.grandviewresearch.com/industry-analysis/attention-deficit-hyperactivity-disorder-adhd-market

**Android rating:** 4.1 stars

**Price**: Free with in-app purchases for the basic version or $7.99/month for premium

**Description:** Type in to-dos, add reminders, check handwritten notes, take photos, and save websites and videos to remind yourself of a mission. A search feature finds everything you've stored in a breeze, so Evernote will help you find what you need when you need it, even though you're not the best at organizing your folders. Evernote is a perfect choice to jot down some stray thoughts to be followed later so that you can remain on assignment now.

***REMEMBER THE MILK***

**iPhone rating**: 4.7 stars

**Android rating**: 4.6 stars

**Price:** Free with in-app purchases

**Description:** Increase the chances of having assignments completed by making priority lists of their subtasks and increase the feeling of achievement. Assign due dates to each and add notes to include useful information that you need to complete the assignments, such as locations, keys, specifics, texts, or emails. With your choice of smartphone alerts, calls, or messages, the app will inform you of upcoming due dates.

***ASANA***

**iPhone rating:** 4.7 stars

**Android rating:** 4.5 stars

**Price:** Free

**Description:** Asana is a free platform for planning and cooperation. Use it to build to-do lists and to incorporate dates and information that are due. Asana is also great for bringing order to your personal life, as it facilitates team collaboration: assigning assignments to others, viewing project board tasks, and keeping tabs on what you and others have been assigned. It is clear after you have delegated a task, so you cannot lose track of or repeat tasks.

***ADHD INSIGHT***

**Android rating:** 3.4 stars

**Price:** Free

**Description**: Parents & caregivers can quickly capture an accurate record of how their child is doing in just a few minutes a day with the ADHD Insight app. The app helps you to configure a daily tracker and keep track of good days and poor days, analyze the success of your child on developmental milestones and take notes, customize reminders to send you a subtle nudge when it is time to track, understand trends, and patterns over time through clear maps, use knowledge to drive richer conversations with healthcare professionals.

***ATTENTION EXERCISE***

**Price:** free, APK compatible with android

**Description:** Using basic drawing exercises that only take a minute a day, Concentration Exercise sharpens your ability to concentrate. Your attention span can get longer with regular use. For enhanced performance, consider using the Daily Reminder environment. This software is targeted at persons with attention deficit hyperactivity disorder (ADHD) or attention deficit disorder (ADHD) (ADD). Yet attention exercise will assist someone to lengthen the duration of attention and increase concentration.

***HOMEY CHORES AND ALLOWANCE***

**iPhone rating:** 3 stars

**Android rating:** 2.8 stars

**Price**: $4.99 per month

**Available for**: iOS, Android

**Description:** Giving tasks to children with ADHD can help develop their self-esteem and management skills. Yet it can be daunting for children with concentration difficulties to keep track of household duties and allowances. The method can be made smoother by Homey Chores and Allowance. The software will set activities for the entire family on a regular, weekly, or monthly basis. It also synchronizes through different computers, so you can be on the same page with children and parents. The app will also monitor earning targets and connect the bank accounts of family members.

***ROOSTER MONEY***

**iPhone rating:** 4.7 stars

**Android rating:** 4.6 stars

**Price:** Free (in-app purchases)

**Available for**: iOS, Android

**Description:** In children with ADHD, issues with handling money are normal. Rooster Capital will help educate them about finance. The app helps parents and children to track pocket money and allowances into a bank account for practice. You should set up periodic payments for allowances and check to see how much money your child has. You will deduct it from the app when you send your child paper money. To see how much money they have invested and saved, children will use the software.

***STOP, BREATHE, AND THINK KIDS***

**iPhone rating:** 5 stars

**Price**: Free (more activities can be purchased) Available for iOS

**Description:** Mindfulness can be a helpful method for helping children control the effects of ADHD. 15 free mindfulness exercises are provided by the Pause, Relax, and Consider app. For a premium, more are available. Kids will "check-in" with the app as they feel, and then pick an activity based on that feeling. Children can be told to imagine a calming scene, breathe slowly, or pay attention to what they experience, to help build a sense of peace.

***CONVERSATION PLANNER***

**iPhone rating:** 4.7 stars

**Price:** $2.99 for each level

**Available for:** iOS

**Description:** ADHD can socially influence children, including finding a conversation difficult to understand. The Talk Planner will help your child exercise. The software shows children how to brace for other persons' experiences. It has more than 130 scenarios for social skills distributed across 18 stages. Of the stages, four are free. Kids select a speaking partner and two interaction targets in each case, one for themselves and one for the partner. The next level is unlocked until kids master one level.

### *6.3.2 Indirect competitors*

Indirect competitors are vendors whose goods or services are not similar, but who can meet the needs of the same customer. Among the ADHD Data Bracelet App's indirect competitors there are role games, therapeutic devices, and behavioral/psychological therapy.

***THE SIMS FREEPLAY***

**iPhone rating:** 4.8 stars

**Android rating:** 4 stars

**Price:** Free (in-app purchases)

**Available for:** iOS, Android

**Description:** FreePlay Sims is an open-ended experience of living with young adults. In the game, children build a "Sim" or a computer character with a personality and an interest. It will help children with ADHD develop the everyday skills they can need in "real life." Sim has criteria such as food, sleep, personal health, social interaction, and fun. Children must lead their Sim to take steps to satisfy the needs of the Sim, as they build and furnish a home, seek work, and develop relationships.

***THE ETNS SYSTEM***

**Price: $**980

The portable electronic device that delivers low-level stimuli to the trigeminal nerve of the brain is the eTNS device intended for use in children aged 7 to 12 under the supervision of the caregiver. Electrodes added to the forehead deliver eight hours of treatment every night while the infant is sleeping. The eTNS procedure, which has now been studied as a potential assist for autism, epilepsy, and post-traumatic stress disorder in adults, has now been shown to demonstrate clinically important changes in the effects of ADHD in a clinical trial. This new device offers a safe, non-drug option for the treatment of ADHD in pediatric patients by mild nerve stimulation, a first of its kind.

The Food and Drug Administration granted marketing permission for the prescription-only product to the biotechnology firm NeuroSigma, which is used for new low-to moderate-risk products with no current market counterpart.

The behavioral improvements observed are comparable to those documented by non-stimulant treatments for ADHD, such as atomoxetine and guanfacine, in terms of medication effect duration, but less pronounced than the effects of stimulant drugs.

More than half of eTNS children experienced side effects such as tiredness, headache, and increased appetite.

***THE ENDEAVORRX DEVICE***

**Price:** $ 489 for 3 months

EndeavorRx is a non-drug solution to improve childhood ADHD-related symptoms and is a notable example of the growing field of digital therapy. The FDA (Food and Drug Administration) is committed to establishing regulatory frameworks to ensure that patients have prompt access to safe and effective specialized digital therapy.

Frustration, headache, dizziness, emotional reaction, and aggression are the most common adverse events observed with EndeavorRx.[27]

***BEHAVIOURAL THERAPY***

**Price:** $200-2000

Some indirect competitors may be those providing behavioral and skills/acquisition therapies. These types of treatments can be deemed more successful by parents when they are realized through the physical presence of the infant and not by a diagnostic or technical system that may be considered more impersonal and effective.

And if a more customized therapy in which the infant is more involved may be the biggest benefit, this approach can still have certain negative implications. Nowadays, parents are often too distracted and either do not have the time available to accompany their children to a counseling session or cannot take days off from work to accompany them through the therapy process so that technologies and apps such as the ADHD Digital Bracelet App can offer a solution to this problem, provided that they can connect parents to a specialist on the internet without a physical appointment. Another negative fact is the more expensive cost of these treatments relative to apps and bracelets.

[27]https://www.fda.gov/news-events/press-announcements/fda-permits-marketing-first-game-based-digital-therapeutic-improve-attention-function-children-adhd

### *6.3.3 Competitors table*

*Table 4- Competitors table, own source*

| | **Price** | **Issue treated/function** | **Compatible** | **Rating** | **Comment** |
|---|---|---|---|---|---|
| Due-Reminders&Timers | $6.99 | -Memory | IOS<br><br>Android | IOS 4.4<br><br>Android 4.1 | Basic reminder<br><br>Does not treat other ADHD issues, just memory |
| Evernote | Basic version free<br><br>$7.99/month premium version | -Memory<br>-Organization | IOS<br>Android | IOS 4.4<br>Android 4.1 | Basic reminder and organizer<br><br>Does not treat other ADHD issues, just memory |
| Remember the milk | Free with in-app purchases | -Memory<br>-Accomplish assignments | IOS<br>Android | IOS 4.7<br>Android 4.6 | Helps to achieve a prefixed task<br><br>Does not treat other ADHD other issues, just memory |
| Asana | Free | -Planning | IOS<br>Android | IOS 4.7<br>Android 4.5 | Activities planner<br>Does not treat other ADHD issues, just memory |
| ADHD insight | Free | -Planning Tracker<br><br>-Connection with professionals | Android | Android 3.4 | It is the app with more functions and the one that treats more ADHD issues, not just one |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | Low customer's rating |
| Attention exercise | Free | -Attention | Android | | Provide attention exercise to improve inattention |
| Homey Chores and Allowance | $4.99 per month | -Reward system<br>-Self-esteem | IOS<br>Android | IOS 3<br>Android 2.8 | Low customer's rating |
| Rooster money | Free (in-app purchases) | -Money management | IOS<br>Android | IOS 4.7<br>Android 4.6 | Help children with ADHD to manage money<br><br>Does not treat other ADHD issues, just money management |
| Stop, Breathe, and Think Kids | Free (more activities can be purchased) | -Relaxation<br>-Self-awareness | IOS | IOS 5 | Mindfulness exercises to improve self-awareness<br><br>High customer's rating |
| Conversation Planner | $2.99 for each level | -Social skills | IOS | IOS 4.7 | Development of social skills<br><br>Expensive |
| The Sims FreePlay | Free (in-app purchases) | -Social skills | IOS<br>Android | IOS 4.8<br>Android 4 | Social skills can be developed<br><br>Game no therapeutic functions |
| The eTNS system | $980 | -All ADHD issues | | | Expensive<br>Side effects |

| | | | | | |
|---|---|---|---|---|---|
| The EndeavorRx device | $489 for 3 months | -All ADHD issues | | | Side effects |
| Behavioral therapy | From $200-2000 | -All ADHD issues | | | Expensive<br><br>Needs time |

## 6.4 Conclusions for the competitors' analysis

Considering the competitors' analysis above we can say that the ADHD Data Bracelet App is the most effective product among the direct competitors, in fact, its treat all the main issue of ADHD. It is a reminder, an organizing tool, it offers breathing exercises to improve self-awareness and self-control, it provides the children with emotional explanation and directly connects the parents/teachers to professionals and experts.

The product studied in this thesis seems to be more complete if compared to other applications that treat just an issue at a time. Most applications provide the users with functions that help to treat one issue like a to-do list for memory, breathing exercises for self-awareness, and so on, the ADHD Data Bracelet App gives the possibility to treat more issues through a multifunction product.

Moreover, most of the apps mentioned above are for adults, or children cannot use them during the entire days because a child of four years old does not have a personal phone or tablet so it can use it just when he/she comes back home for school and a limited period.

With the ADHD Data Bracelet App, the child is 100% involved he/she has his or her device, the bracelet, that can carry around all day and use anytime and in all circumstances. The bracelet is connected to an app that the adults, parent, or teacher, has installed on a mobile device. In this way, the product has a device for the child and an application for the adults, and both are involved in the therapy in the same way and will have a positive effect on the child that will feel excited to have his technological device.

Considering the indirect competitors if compared to games this app is more specific and has more functions that will target more issues connected to the disorder.

Therapeutic devices can be considered more efficient and reliable, but has side effects and are expensive if compared to the ADHD Data Bracelet App

## 6.5 Why an application?

The number of available mobile apps designed for the management of ADHD has increased in recent years.

As already explained before ADHD can be treated and the National Institute for Health and Care Excellence guidelines say that there are three main types of treatments:

1. Pharmacological treatment (methylphenidate or amphetamines),
2. Psychological treatment,
3. And a combination of both.

That said it should be underlined the fact that some children do not respond to pharmacological treatments. How this problem can be faced? A solution could be the technological or "computerized" intervention.

According to Păsărelu et al. (2020) Access to treatment in remote places, cheaper costs compared to face-to-face treatment, and several other benefits for both patients and therapists have all resulted from advancements in mental health care. Computerized therapies, Internet-delivered interventions, gamified interventions, and mental health apps have emerged as potentially promising options in the treatment of mental conditions, as they can remove barriers to the diffusion of evidence-based therapy.

Păsărelu et al. (2020) analyzed 109 ADHD app, most of them designed for treatment, ADHD assessment, or for both purposes. They recognized numerous key treatment modalities proposed by these apps, such as tracking and monitoring ADHD pharmaceutical treatment, organizational skills training, psychoeducation, hypnosis, cognitive training, neurofeedback, or music therapy.

Păsărelu et al. (2020) also noticed some negative aspect of these applications:

- Few of them allow direct communication with the patient's physicians,
- Very few apps described the empirical support/theory they draw on,
- Some are complex to use,
- Scarce video and audio feedback, information is in most cases written and difficult to understand,
- Most of the apps cannot be customized,

- Few of them can be used together by parents and children, so it is difficult to improve their relationship.

One of the main impairments is that few applications were tested so there are scarce data that prove the efficiency of technological ADHD treatments. This is still an unexplored field that needs more research and investments.

Starting from this information, I decided to create an application capable of solving the problems and negative aspects of existing apps that were based on a solid scientific basis and able to satisfy the real needs of the end-user.

## 6.6 Segmentation

### *6.6.1 Customer identification*

As shown before the market for the studied product is wide enough to guarantee profits, but after careful examinations, it has been decided to target certain groups of people. Customers who fall in the following categories are the ideal customers:

- Children diagnosed with ADHD,
- Children and young adults from 6 to 19 years old,
- Parents of children that were diagnosed with ADHD,
- Parents who work and have limited time,
- Teachers and professors that have alumni with ADHD,
- Families with young children that show early signs of ADHD,
- Therapists with young ADHD patients.

### *6.6.2 Definition of market segmentation*

According to Kotler et al. (1999), The market consists of several classes of customers, products, and needs. The market segment consists of customers who respond in a similar way to a series of marketing stimuli. There are several ways of segmenting the market, but not all segmentations are successful. Market groups must have the following attributes to be useful: measurability, accessibility, and sustainability.

*Measurability*: the scale, purchasing power, and section profiles need to be calculated. Any segmentation variables are difficult to quantify.

*Accessibility:* Should business categories be entered and served effectively? Not all targets are accessible.

*Sustainability*: market segments are large or lucrative enough to serve them.

There are four types of market segmentation: geographic, demographic, psychographic, and behavioral.

### *6.6.3 Geographic segmentation*

Geographic segmentation calls for the separation of the market into separate regional divisions, such as countries, regions, cities, counties, neighborhoods, or communities. An individual chooses to operate in one or a few geographical areas or to operate in all areas while paying attention to geographical variations in needs and wishes (Kotler et al., 1999).

Considering the geographic segmentation criteria, the ADHD Data Bracelet App will be distributed in the European continent as a first step:

- In any developed country or region of Europe, starting from Portugal,
- High-density areas like big cities (Lisbon, Porto),
- Areas with a high concentration of schools, and psychology university that could accept to test the product.

### *6.6.4 Demographic Segmentation*

Demographic segmentation consists of dividing the market into categories based on variables such as age, gender, family size, life cycle, income, profession, schooling, religious faith, race, and nationality. Demographic variables are the most common basis for segmenting consumer categories. One explanation is that customer needs, wants and rates of use frequently differ strongly with demographic variables. One is that demographic factors are simpler to measure than most other variable types.

- Age: the ADHD Data Bracelet App will be a product for children and young adults from 6 to 19 years old.
- Gender: the product is not gender based.
- Family size: The product will be directed to all those family that has a young member with ADHD.
- Life-cycle stage: the product will be launched mainly during the scholar period when children and adolescents go to school.
- Income: the segment targeted will be that of middle-class families with an average income.

- Profession: This product was created for alumni, teachers, and professionals that work with people diagnosed with ADHD.
- Schooling: this product is designed for students and teachers from elementary school through high school.
- The ADHD Data Bracelet App is an inclusive product for all religions, faiths, nationalities, and races.

### *6.6.5 Psychographics segmentation*

The psychographic segmentation approach is based on an interpretation of the lifestyle of the target, seeks to relate attitudes articulated towards the product/service to habits, desires, and beliefs, and tries to create a link between purchasing behavior and personality variables.

Lifestyle is organized around three layers of study that are more or less similar to the act of buying, namely: human beliefs and habits, desires and views, goods bought and consumed.

In this sense, behavioral segmentation focuses specifically on buying behavior, taking into account: the type of customer, the rate of usage of product acquisition options, the degree of loyalty, and the sensitivity of marketing elements.

According to the psychographic segmentation, the ADHD Data Bracelet App will have as a target:

- Children and young adults that have ADHD,
- Children and young adults that go to school and look at education as a fundamental factor,
- For those that have an active lifestyle,
- Young people busy between school and extracurricular activities need to organize their activities and not forget them.

### *6.6.6 Behavioral segmentation*

In line with Kotler et al. (1999), an important approach for segmenting users is to classify them into customer groups with identical behavior. It includes the study and aggregation, in a homogeneous whole, of consumer categories, based on their purchasing response to such commercial demands, the level of brand loyalty, the frequency of use of particular services or goods.

Thanks to behavioral segmentation, it is possible to deliver customized messages to consumers or prospective customers that are more likely to reply.

The ADHD Data Bracelet App will be for:

- Children and adolescents that want to give their life a better structure and organization,
- People with ADHD who would like to be productive and more self-aware,
- Children and young adults want to feel more connected in a social environment such as school and not feeling any different and pointing out their strong point,
- Experts that should adopt and suggest the ADHD Data Bracelet App to their patients.

# 6.7 Positioning

According to Kotler and Armstrong (1999), positioning is the role of the product /brand in the minds of customers. If a product is considered to be just the same as any product on the market, customers would have no incentive to purchase it. Market placement offers a product a simple, distinctive, and attractive role in the eyes of the target customers relative to rival products or brands.

## *6.7.1 ADHD Data Bracelet App positioning*

To position the ADHD Data Bracelet App, as suggested by Kotler and Armstrong (1999), two factors have been considered: the product and the market.

As seen in the figure below, the ADHD Data Bracelet App is a new product that is attempting to penetrate an already developed market so that product development is the right approach to pursue. In this way, the positioning itself reflects on the features of the product, its physical attributes, its intangible attributes, and all the benefits that the product can offer to the consumer.

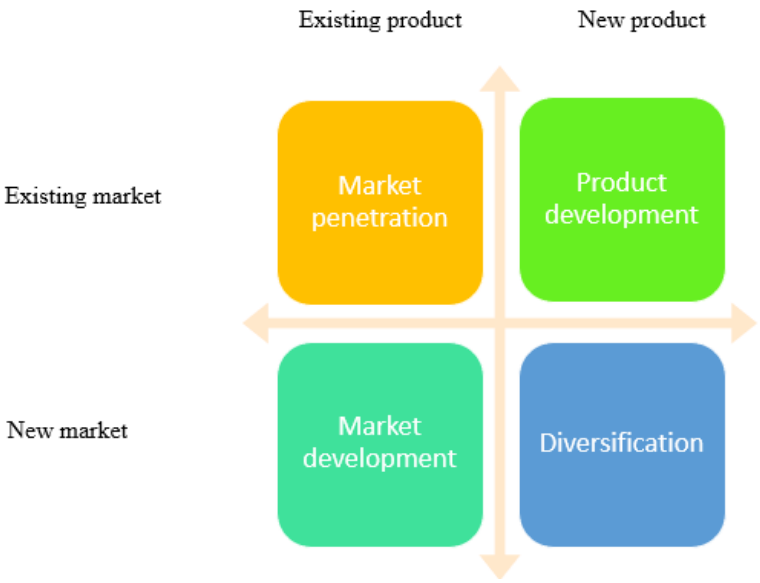



*Figure 13- Positioning*

The positioning will be based on the product's main features and its competitive advantage.

The product has the advantage of being both a leisure and therapy tool for ADHD. The applications proposed by the competitors to be used require a mobile device, a smartphone, or a notebook, tools that the youngest do not have. In this way, apps can only be accessed at home, via parents' devices, and not at school. On the other hand, through the ADHD Data Bracelet App, children and teenagers can access the app even at school with a "bracelet" equivalent to a smartwatch that they can use at any time.

The product if compared with the therapeutic tools listed above such as the eTNS system and the EndeavorRx device, would not present all the side effects that these devices have.

An emotional dimension to be stressed is the feeling of involvement that this product will create in children who feel happy to have their own devices that are not only "cool" but can also help them overcome their challenges in any social sphere.

A bracelet/smartwatch is also a very common and widely used device, not a strange or bizarre device that can make the user feel uncomfortable.

Another benefit is that this product is not only for people with ADHD and parents, it would also make it easier for teachers to be involved in the child/adolescent therapeutic process to support the school with the right skills and understanding of ADHD.

The ADHD Data Bracelet App wants to be perceived as a product that can be associated with a therapy for ADHD through a digital and light approach.

## 6.8 The marketing mix

The marketing mix is defined as the set of controllable tactical marketing instruments that are used to generate the desired response in the target market. The positioning strategy must be supported by the entire marketing mix that is also called the 4Ps: Product, Price, Place, and Promotion. (Kotler et al., 1999).

***Product***

The product is the goods or the service that is offered to the market and for this thesis, the product is the ADHD Data Bracelet App, an application that assists people with ADHD and their families. The app is connected to a bracelet that will be used by children with ADHD, while the application is designed for parents, teachers, and professionals that surround them.

As explained before the app has various features that target the main issues of ADHD and its functionalities have been designed considering the medical literature on ADHD and the opinion of experts, psychologists, psychiatrists, and behavioral experts.

***Price***

The price is what customers pay to get the product.

ADHD is a disorder that needs the best assistance possible, and to provide a good service always updated with research on ADHD treatment, the app will be a paid app that can be downloaded and used with a monthly subscription.

Păsărelu et al (2020) analyzed 109 ADHD App and noticed that the average price for them was $4.48 (€3,75), the most expensive was $14,99 (€ 12,56), and the cheapest $0,99 (€0,83).

Considering this data and the beneficial aspect of the ADHD Data Bracelet App, its price could be €4,99 per month, a price that can change once there will be evaluated all the costs to develop the application itself.

The bracelet will have a cost to be defined on the materials and technology used to produce it, but it should have an available price for all the families that have a child with ADHD so the idea was that to create a bracelet that has a range price from €19,99 to €39,99. The

bracelet will be more or less expensive based on the level of personalization required by the customer.

***Place***

Place includes activities that make the product available to target consumers. The app will be available both for IOS and Android devices so it could be downloaded through Apple Store or Play Store.

The ADHD Data Bracelet will be available on both main operating systems as it does not want to bind its use to a specific device belonging to a single brand but wants to be as accessible as possible to its final users.

The bracelet will be proposed by experts, at the beginning it won't be available on the GDB. It is important to underline the fact that this is a bracelet build to help people dealing with a Mental health issue, that was developed after carful studies and it is not a commercial product, but a medical one that should be used following experts advices.

***Promotion***

According to Kotler et al. (1999), promotion means activities that communicate the merits of the product and persuade target customers to buy it.

The ADHD Data Bracelet App aims to help daily children and adolescents who have ADHD, a disorder recognized among mental illnesses.

This product targets young people and families that have to manage a very complex disorder and for this reason, the ADHD Data Bracelet App needs to be supported by professionals.

The communication campaign should be based on partnerships with associations for children diagnosed with ADHD, psychiatrists, psychologists, neurologists, and behavioral therapists who, enthusiastic about the product, could recommend it as excellent support for children and adolescents with this disorder.

The partnership can be realized throughout the help of all the experts that answered to the questionnaire and showed enthusiasm about the realization of a prototype because they wanted to test the efficacy of the ADHD Data Bracelet App.

At psychology universities could be organized events with psychology students, teachers and experts to present the product its functionalities to convince the participants to start a research that aim to create the product and test it.

Among the associations in Portugal, the product could be presented and sponsored by:

- SPDA – Sociedade Portuguesa de Défice de Atenção,
- APCH - Associação Portuguesa da Criança Hiperativa.,
- Clube PHDA.

Among the experts, there was a good number of those who answered the questionnaire that showed enthusiasm among the product and would like to test a prototype to see its effectiveness.

The product could be also sponsored among psychology universities and can be tested to prove that technological therapy can be effective to face ADHD.

The main objective of the promotion is to make people understand that the ADHD Data Bracelet App is a reliable product that was developed after careful studies on the disorder and the best way to show that is through the support of professionals that suggest it as a good and helpful product.

The communication cannot be realized using only conventional means, it should always be supported by experts, so an idea it is that of communicating with the final user through fairs and events organized for example during the ADHD awareness month. It is important to be present during these events because there are final customers and experts that are interested on new product to help them treat ADHD.

## 6.9 The SWOT analysis

A SWOT allowed an internal (strengths and weaknesses) and external (opportunities and threats) analysis that involved the product itself and the market where the product will enter.

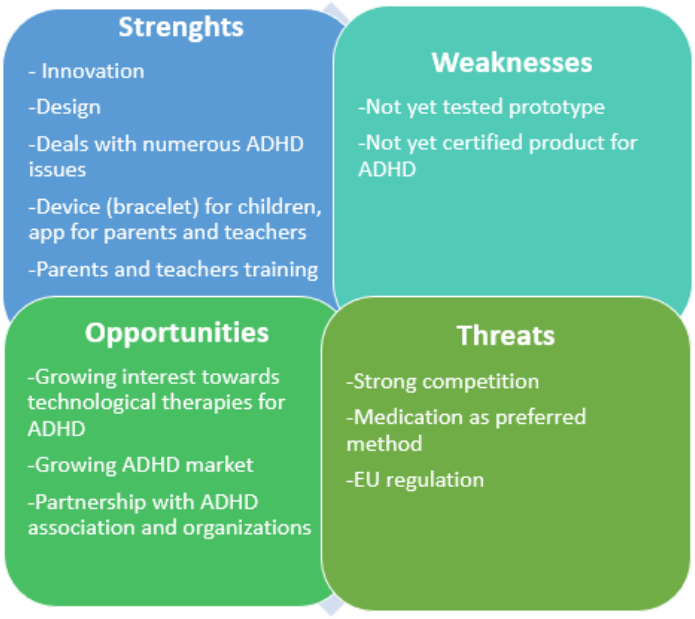



*Figure 14-SWOT, own source*

- **Strengths**: among the strengths of the ADHD Data Bracelet App there is the innovation the product brings to the market. The product offers an alternative or support for all the known ADHD therapies both medical and technological. The Product is portable, and it looks like a normal smartwatch, a characteristic that will not make the children uncomfortable among his/her peers. The Bracelet is modern with an attractive design for both children and adolescents who will be able to customize the smartwatch by choosing its color. The ADHD Data Bracelet will not look like a medical or unusual tool that could make the child feel uncomfortable in social situations, but it will perform the functions of a normal smartwatch and will be calibrated with specific functions for managing ADHD. The App installed on the bracelet will not be a simple reminder to notepad, like most app for ADHD, but will offer eight features to treat not just one but multiple issues of ADHD: Emotions management, attention problems, distraction tendency, self-control, anger management and the difficulty to use what learned. The ADHD Data Bracelet App is not just a treatment device for just for children or just for parents/teachers but is a device able to connect all of them through a bracelet (for children) and an application for parents and teachers. The Bracelet also offers a training function for adults that deal with children with ADHD, because spread knowledge about the disorder and teaches both to de adults and children how to deal with ADHD.

- **Weaknesses:** The product has not a tested prototype so it is not ready for tests that will prove its functionality and even less the quality of its performance. For this reason, it cannot be said that the ADHD Data Bracelet App is an existing and functioning product ready to use and which can be tested by the final consumers. Furthermore, the ADHD Data Bracelet is a product that will face the issues of a neurodevelopmental disorder therefore it might need a certificate attesting to the effectiveness of the ADHD treatment without harm to the user, a certificate that it does not have, and that will require a long period to be obtained.
- **Opportunities:** An opportunity of success for the product could be a growing interest and investments towards technological therapies for ADHD that with a growing ADHD market lies the basis for a positive entry in the market. Another opportunity could be that of realizing a partnership with ADHD associations and organizations that will promote the ASHD Data Bracelet App among their members and will provide support for the image of the product giving it credibility. It is also important to consider the opportunities identified with the PESTAI.
- **Threats:** The growing interest in technological therapies for ADHD also leads to stronger and wider competition. Another threat could be the battle between technological therapies and drugs for ADHD on a market that always saw the win of the medication that is the preferred therapy for ADHD. Finally, some EU regulations can slow down the developing process also increasing the budget needed for the realization of the ADHD Data Bracelet Product. It is also important to consider the threats identified with the PESTAI analysis.

# 7. Managerial implications

Following the analysis of the literature and the answers to the questionnaire, the next step is to create a prototype of the ADHD Data Bracelet App, involve the experts that answered the questionnaire in the testing process and create events to promote the product allowing a bigger testing process.

In this phase it will be essential to involve associations for ADHD and universities of psychology interested in the treatment of the disorder.

To avoid will be the creation of a commercial product, to be launched on the market without the support of experts. This could devalue the credibility of the ADHD Data Bracelet App which aims to be an effective support for professionals dealing with a disorder that is considered a mental health issue.

# 8. Theoretical implication

This thesis and the research that was carried out confirmed the fact that the ADHD Data Bracelet App can be an effective product to treat the main ADHD issue.

The limitations mainly concern the fact that since there is no prototype of the product to be tested, its effectiveness has only a theoretical basis and remains a hypothesis to be tested.

# 9. Conclusions

The ADHD Data Bracelet App is a product that has strong theoretical foundations supported by copious research both primary and secondary.

As shown by the results obtained from the questionnaire administered to the experts, the ADHD Data Bracelet App is a product approved by doctors, psychologists, psychiatrists, and neurologists who have shown enthusiasm for the product and have expressed the desire to be able to use and test a prototype of the app.

Despite the positive results of the questionnaire the ADHD Data Bracelet App is a product that wants to help those who have a disorder inserted among the mental illnesses, so it will have to be introduced on the market with great caution.

The marketing plan implemented with this thesis wants to create a reliable image of the ADHD Data Bracelet App and for this reason it wants to introduce it on the market through

doctors, psychologists, psychiatrists and neurologists who have the competence to evaluate a product for the treatment of a disorder as complex as ADHD.

An aspect that this thesis wants to underline is the connection that the product creates between a child with ADHD, his family and the doctor, a connection that will be essential to obtain an optimal result of the product. It will be in fact through the discussion with the experts that parents, and teachers will be able to use the app avoiding possible side effects such as anxiety.

The limitations to the research are certainly the failure to realize the prototype of the ADHD Data Bracelet App. This does not allow to verify with total accuracy the effectiveness of the product which is judged excellent by the experts only on theoretical and hypothetical basis.

As regards possible future developments, there is the realization of the prototype of the product and its use on an experimental basis to evaluate its real effects.

The product could also evolve from an app to an online platform whose goal is to educate children, adolescents, and adults about ADHD.

The biggest goal of the App will be to make children with ADHD autonomous since after constant use of the product they will develop greater autonomy.

The hope is that after two years of correct use of the ADHD Data Bracelet App, children will need fewer and fewer notifications and reminders.

# 10. Recommendation

There are several points of attention during product production. These recommendations are listed and should be considered during further developments:

-For further development of the watch, a prototype should be made, more details should be taken into account, and a prototype should be realized for different sizes of the smartwatch considering if the final users are children, adolescents, or adults,

-it is to point out the fact that the decision taken and reported in the thesis could change in the process of prototyping,

- The element inside the smartwatch should be modified according to the different ages of the user,

-To develop the App and the Bracelet interface, an UI/UX designer should be contacted and involved in the development process,

-The App interface should be clear and easy to use for parents, professionals, and teachers,

-For the app programming and coding, a computer engineer should be involved in the process,

Packaging:

-The packaging should be made 100% from recycled materials,

-The packaging should also contain clear information about the product and its usage.

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