Deliverable D24.13

Business plan

Consuelo Granata (ACETIAM)

Version 1
Delivery date: **31.01.2019**

This confidential business plan has been prepared solely for the benefit of potential investors. By accepting this document, the recipient agrees to maintain in strict confidence the contents hereof. The recipient also agrees to utilize the information herein solely for the purpose of evaluating the technology as an investment opportunity. Any disclosure or reproduction of the contents of this document without the prior consent is prohibited.

CONTENTS

Glossary of Terms

ECHORD++: European Clearing House for Open Robotics Development Plus Plus (E++ for short)

1 Product overview

ASSESSTRONIC is a powerful tool designed to assist health professionals during CGA process.

It is a modular solution that allows to perform cognitive tests, or physical tests or both, depending on the costumers' needs. In terms of hardware, it requires just a tablet PC running Android OS for cognitive assessment and for managing patients' data and results. For the physical assessment an additional hardware is required, consisting on a compact box embedding a 3D camera used to perceive the patients' body movements and to send the collected data to a remote server, which is used for data analysis and storage.

1.1 Benefit of using ASSESSTRONIC system

The use of the system for CGA process brings several benefits for health professionals and patients

+ Parallelization of the test and time saving for health professionals
+ Ability to manage autonomously the execution of some tests with unbiased test results (less susceptible to the human subjectivity)
+ Ability to interact in a natural way (voice + touch screen)
+ Ability to display information and results in a user-friendly way
+ Ability to record both results and raw data for post processing analysis and later comparison
+ Cost reduction
+ Easy tracking of the patients' performances
+ Decreasing of anxiety experienced by patients during the interviews performed with health professionals

2 Executive summary

ASSESSTRONIC is a powerful tool designed to assist health professionals during CGA process.

It is a modular solution that allows to perform cognitive tests, or physical tests or both, depending on the costumers' needs. In terms of hardware, it requires just a tablet PC running Android OS for cognitive assessment and for managing patients' data and results. For the physical assessment an additional hardware is required, consisting on a compact box embedding a 3D camera used to perceive the patients' body movements and to send the collected data to a remote server, which is used for data analysis and storage.

Additionally, a tailored service of integration of the ASSESSTRONIC system output with the local hospital IT system is offered.

The benefit of using ASSESSTRONIC system are several: increasing the accuracy of the results, reducing the doctor-time involvement (meaning money saving for health providers), reducing the level of anxiety of patients, increasing the objectiveness of the assessment (if the tests are performed by humans the results can be completely objective).

ASSESSTRONIC system will be brought to the market by ACETIAM, the first European Multispecialty Telemedicine Editor and Operator. The company develops solutions for exams production, collaboration between public and private healthcare facilities, medical images and reports sharing with patients and prescribing doctors.

For the health providers, the average cost of the solution for the cognitive assessment will be 800€ the first year and 300€ from the second year (for hosting and support). For the physical assessment module, the average cost of the system will be 3,600€ the first year and 600€ from the second year. If the client will require the integration of the ASSESSTRONIC system with the local hospital information system, the additional average price will be 5,300€ the first year and 1,800€ from the second year afterwards. Considering the statistics of the Spanish hospital Sant Antoni Abat, the return on investment time for cognitive + physical assessment is less than 2 months, thanks to the low cost of the system and to the savings that it allows.

A potential market of 9,832 institutions worldwide and a reachable market of 1,275 institutions considering different penetration rates for different geographical areas have been estimated. The reachable turnovers for first and second years in a world scale are 11,250,662€ and 36,014,068€.

Our strategy is to tackle the European market the first year, and expand to the world reachable market already from the second year of activity. This is an absolutely realistic projection thanks to the solid network of clients that ACETIAM already has in place. In 4 years, the expected revenue is 1,461,300€ selling a total of 480 ASSESSTRONC solutions worldwide.

3 Problem

3.1 Medical context

A fall leads to a decrease in mobility and increases dependence, a loss of confidence and therefore a decline in the person's functional abilities leading to an increase in the number of hospitalizations. In their study, Rockwood [3] showed that this vulnerable population has a significantly higher probability of progressing to a loss of functional independence and being admitted to hospital or institution. However, hospitalization, a major stressor, often has negative consequences for the elderly [4] such as loss of functional autonomy [5] and the occurrence of a disability [4].

Since the risk of falling and the loss of functional independence are highly correlated and predominant for this at-risk population, these polypathological elderly people require comprehensive care enabling regular and personalized follow-up. This monitoring makes it possible to detect, as soon as possible, the degenerations and pathologies related to aging. In addition, because in the elderly at risk of loss of autonomy, once the pathologies installed, the decline can be rapid Although growing well is a major government issue, it is clear that many people aged of 65 and over are fragile, there is a high risk of loss of motor and functional autonomy. A person is considered fragile when he or she meets at least three of the following five criteria: unintentional weight loss (4.5 kg in the previous year), exhaustion, weakness measured by grip strength, speed of slowed down and low level of physical activity [1]. In these conditions, she develops gait and balance disorders as well as great difficulty in maintaining her functional abilities in the long term. According to the health monitoring institute (part of the French health minister), one-third of over-65s living in their homes, and half of the over-85s, have at least one fall per year [2]. The minister lists, each year in France for this population, more than 450 000 falls (80% of the accidents of the everyday life) of which 9 300 are fatal, 70 000 fractures of the neck of the femur, 500 000 passages with urgencies, 100 000 hospitalizations.

A fall leads to a decrease in mobility and increases dependence, a loss of confidence and therefore a decline in the person's functional abilities leading to an increase in the number of hospitalizations. In their study, Rockwood [3] showed that this vulnerable population has a significantly higher probability of progressing to a loss of functional independence and being admitted to hospital or institution. However, hospitalization, a major stressor, often has negative consequences for the elderly [4] such as loss of functional autonomy [5] and the occurrence of a disability [4].

Since the risk of falling and the loss of functional independence are highly correlated and predominant for this at-risk population, these polypathological elderly people require comprehensive care enabling regular and personalized follow-up. This monitoring makes it possible to detect, as soon as possible, the degenerations and pathologies related to aging. In addition, because in the elderly at risk of loss of autonomy, once the pathologies installed, the decline can be rapid, regular monitoring and adaptation to the needs of the patient is needed. To do this, multidimensional geriatric assessment, as an early detection tool, was created in the 1980s [6]. Thus, people at risk of falling, and / or first-time fallers, and people at risk of loss of functional independence are subject to a high level of vigilance with geriatric day hospitals, which largely centre their management on the one hand, the evaluation of the postural instability identified mainly by means of the Timed Up and Go test (TUG) (Podsialo & Richardson, 1991) and, on the other hand, the autonomy functional very often identified by the Barthel index [7].

Currently, these assessments are performed by one or more health professionals using paper questionnaires. Information and communication technologies (ICTs) provide technological tools to improve practices, to free up time for health professionals, while maintaining the necessary and unavoidable analysis of results by them. There is growing evidence from evaluation research that technological supports can bring significant benefits for elderly, while at the same time, improving the cost-effectiveness of health and social services.

In particular, the use of technology in CGA process is a real need for 2 main reasons: reducing the costs for healthcare systems and reducing the time spent by health professionals for assessing the patients. Actually, the limited financial and human resources available for elderlies' assessment entail that the CGA processes are performed in rush and with poor accuracy. Most geriatric assessments, performed under the constraints of time and money, tend to be less comprehensive and more directed. An automation of the process achieved by using a technology solution is highly suitable for absorbing the demand without compromising on the quality of the assessment and containing the costs.

A technological approach is suitable for the parallelization of the tests as well. For instance, the patient and the relative can perform the requested tests simultaneously in 2 separated rooms, without the need of involving 2 members of the medical staff. This means on one hand time saving for medical staff and on the other hand waiting time minimization for patient and relatives (reducing the feeling of anxiety of the patient).

Usually, the process requires professionals to use supporting devices (frequently a computer) or to take note of the observations, which sometimes impedes the interaction between health professionals and patients/relatives because of the visual contact loosing. The communication is so interrupted many times, and the patients feel that health professionals pay more attention to the computer than to them.

Often, the patients feel anxiety during the tests performed by health professionals because they feel as judged and under exam. This affects the tests results because the patients tend to lie about their autonomy in the daily activities. The use of a machine instead of a human being should be felt as more neutral and could entail more truthful results.

Some of the tests of the CGA process require the health professional to interpret the results because of the lack of precise parameters. In fact, the same test for the same patient can have different results if performed by 2 different health professionals. This lack of objectiveness can be compensated by using a machine, which considers always the same quantitative and qualitative parameters for scoring the tests.

4 Product

The ASSESSTRONIC solution is designed to do autonomously or assist the caregivers during the CGA process to assess patients' functional, mental and physical conditions.

The main benefit that the use of ASSESSTRONIC system has compared to traditional approach are:

+ Time saving for health professionals
+ Cost effectiveness for healthcare systems
+ Tests parallelization (time saving and lower stress level for patients and relatives)
+ Gain of objectiveness for some standard tests
+ Gathering of richer and finer information
+ Reduce patients' anxiety during the tests
+ Easy tracking of patients' status

4.1 Use workflow

The use workflow is shown in Figure 1. The light blue background indicates the steps where the solution is used.

This workflow has been designed considering the indications of the standard CGA procedure followed in ABAT hospital. After patient and relative have booked in, they are asked to wait in the waiting room. They are then invited for an initial interview with the doctor. After that, in the current practice, patient and relative are asked to perform some standard tests with the doctor. Using the system, some tests can be performed completely autonomously by relative and patient, others with the assistance of a nurse. This mean that the time spent by the doctor in the process is considerably reduced. After the tests, patient and relative are seen again by the doctor for the final medical diagnosis. Eventually, they can leave the hospital.

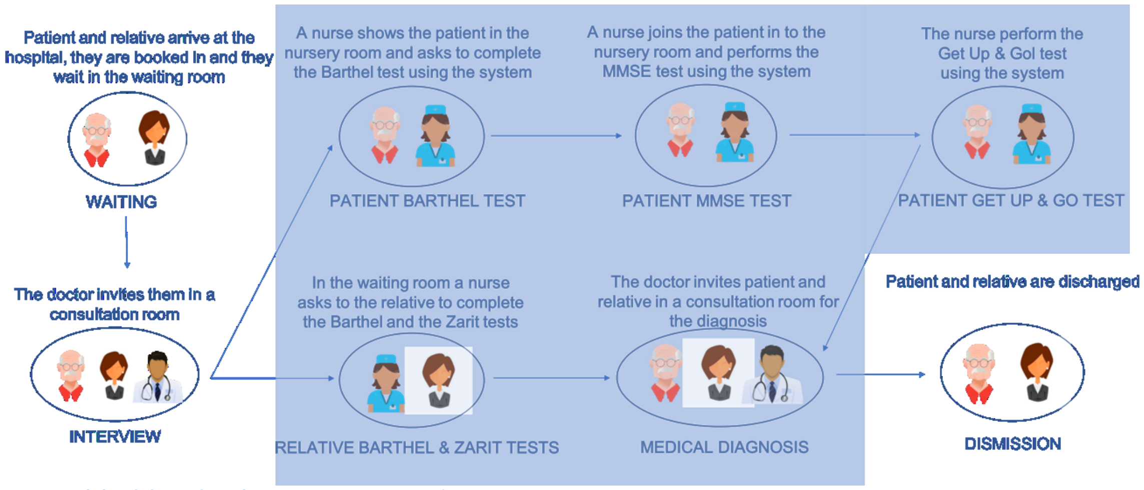


Figure 1 ASSESSTRONIC system use workflow.

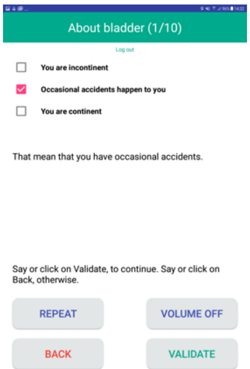
4.2 Key features

- User Experience and Social Acceptance. The system usability has been assessed and validated by a multidisciplinary team made of engineers, psychologists, psychiatrists, geriatricians and neuropsychologists
- Portability. The solution is easily manageable and portable
- Modularity. The solution is modular and flexible in order to accommodate different needs in a cost-effective way
- Parallelization. The tests can be performed in parallel to save health professionals' time
- Objectivity. The solution can perform autonomously some tests with unbiased test results (less susceptible to the human subjectivity)
- Natural interface. The patient can interact with the system in a natural way (voice + touch screen)
- Results readability. The results are displayed in a user-friendly way and are easy to understand for everyone
- Data collection and storage. Both results and raw data can be collected and stored for post processing analysis and later comparison
- Cost reduction. The doctors' time spent for each CGA process is considerably reduced when the solution is used
- Performance tracking. Easy tracking of the patients' performances with results easy to read and compare
- Patient emotional benefit. Decreasing of anxiety experienced by patients during the interviews performed with health professionals

4.3 The system

It is a modular solution consisting on 2 different components to maximize the possibility of tests parallelization while limiting the costs for the hospitals. The idea is to allow the use of the technology that is strictly necessary for each test and avoiding unnecessary complexity (and consequently costs). The solution proposed is structured on 2 modules:

+ The cognitive assessment module: it consists on an application for Android tablet PCs running an interface that can be used by the patients and relatives for the tests and by the doctors both to perform the tests and to access to patients' data



+ The physical assessment module: a compact and portable device used for performing physical-based tests. It embeds a 3D camera which is used to observe the patients' movements during the physical tests.

Tthe cognitive and physical assessment modules communicate with each other and with a server where all the patients' data are stored and where the analysis of body movements during physical tests is performed.

4.4 The interfaces

The user interface runs on Android tablets. The software can be run on 3 different modes:

+ Patient mode, to present the survey forms to be performed by the patients and see some results
+ Relative mode, to present the survey form to be performed by the relatives and see some results

+ Physician mode, to perform manually the tests, to consult and modify the tests results and manage the patients' data (including adding and updating new patients in the database)

During the tests, the patient can interact with the system through the touch screen or through the voice. Google speech recognition and synthesis have been integrated in the interface in order to offer to the user an interaction channel as natural as possible.

4.5 The hardware

The physical assessment module embeds an ORBBEC Persee camera which runs a skeleton detector and tracker software during physical tests and collect the skeleton data. This data is sent to the server for storage and analysis.

The server is used both as database to store raw and processed data (videos, audio tracks, tests results etc.) and as processor to compute the results of the physical tests.

All the necessary backend services for client software are provided as webapi in REST style.

5 Market Analysis

5.1 Market size

Target aim of ASSESSTRONIC is to state-of-the-art technology device and solutions, and become the leading provider of technology for assisting health professionals during CGA process (and potentially other evaluation processes) in all health care provider facilities practicing assessment of elderlies. For practical market assessment the population aged over 65 years estimated by the World Bank in 2025 has been considered. In order to have a realistic idea of the potential markets in the different countries, the French market data in 2014 has been took as reference. That year in France, the population aged over 65 years was 12,578M and 201,248 CGA have been performed. Considering that the number of CGA processes performed correspond to only the 1.6% of the population aged over 65 and this ratio to all the others markets has been applied. As in France, 201,248 CGA performed in 2014 were accommodated in 190 institutions, it has been considered that in average an institution is able to perform 1,059 CGA processes per year. The potential markets in different countries from the estimated population over 65 can be projected, considering also that the number of CGA process correspond to only 1.6% of elderlies over 65 and that each institution can perform around 1,059 tests per year. The estimations are listed in Tables 1 and 2.

Table 1 European potential market for ASSESSTRONIC in 2025.

	Population age 65+	*Performed CGA*	*Number of institutions*	*Potential turnover first year (€)*	*Potential turnover from second year (€)*
Finland	1,120,000	17,920	17	72,343	232,357
France	13,110,000	209,760	198	846,803	2,719,830
Germany	16,800,000	268,800	254	1,085,148	3,485,365
Italy	13,266,000	212,256	200	856,879	2,752,193
Romania	3,145,000	50,320	48	203,142	652,468
Slovak Republic	702,000	11,232	11	45,344	145,639
Slovenia	378,000	6,048	6	24,416	78,421
Spain	8,370,000	133,920	126	540,636	1,736,458
Sweden	2,080,000	33,280	31	134,352	431,522
Switzerland	1,602,000	25,632	24	103,477	332,356
Turkey	5,775,000	92,400	87	373,020	1,198,095
Ukraine	6,405,000	102,480	97	413,713	1,328,797
United Kingdom	11,679,000	186,864	176	754,372	2,422,952
TOT	**84,432,000**	**1,350,912**	**1,275**	**5,453,645**	**17,516,453**

The estimated turnover for the first year in the European countries listed in Table 1 is 5,453,645€ the first year and 17,516,453€ from the second year onwards (this estimation includes support and hosting costs of existing clients from the first year and a number of solutions sold tripled with respect to the first year). These turnovers are calculated considering an average selling cost of 4,276€ for each solution and an average operational cost of 906€ from the second year onwards. The potential turnovers for first and second years in a world scale are 42,041,735€ and 128,708,531€ (see Table 2).

Table 2 World potential market for ASSESSTRONIC in 2025.

	Population age 65+	**Performed CGA**	**Number of institutions**	**Potential turnover first year (€)**	**Potential turnover from second year (€)**
East Asia & Pacific	214,650,000	3,434,400	3,242	13,864,704	44,531,769
Europe & Central Asia	137,850,000	2,205,600	2,082	8,904,027	28,598,669
Latin America & Caribbean	48,580,000	777,280	734	3,137,886	10,078,514
Middle East & North Africa	24,945,000	399,120	377	1,611,251	5,175,145
North America	57,510,000	920,160	869	3,714,694	11,931,152
South Asia	98,100,000	1,569,600	1,482	6,336,489	20,352,044
Sub-Saharan Africa	38,760,000	620,160	585	2,503,592	8,041,238
World	650,880,000	10,414,080	9,832	42,041,735	128,708,531

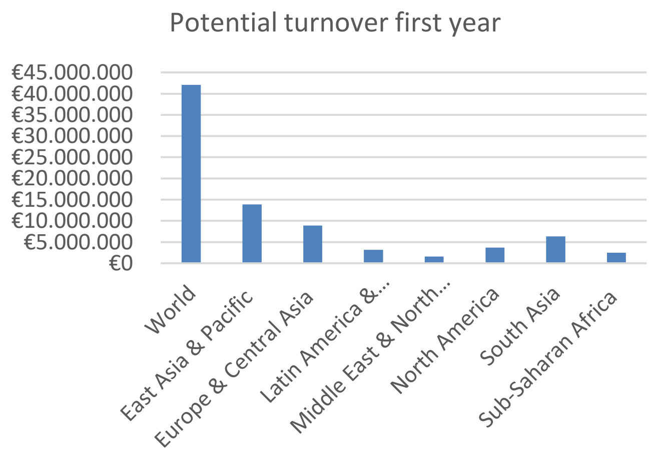


Figure 2 Potential turnover estimated for first year.

5.2 Reachable market

Analysing the potential market and expecting different penetration rates considering the different maturity levels of regional markets, the estimated reachable turnover is shown in Tables 3 and 4. The reachable turnover for the first year in the European countries is **2,327,441€** the first year and **7,341,509€** from the second year onwards. The reachable turnovers for first and second years in a world scale are **11,250,662€** and **36,014,068€.**

Table 3 European reachable market for ASSESSTRONIC in 2025.

	Number of institutions	***Penetration rate (%)***	***Reachable turnover first year (€)***	***Reachable turnover from second year (€)***
Finland	17	35	34,412	108,627
France	198	35	420,086	1,323,044
Germany	254	35	539,411	1,698,776
Italy	200	35	424,348	1,336,464
Romania	48	15	28,872	93,139
Slovak Republic	11	15	5,220	17,155
Slovenia	6	15	2,023	6,884
Spain	126	35	266,669	839,962
Sweden	31	35	64,243	202,559
Switzerland	24	35	54,953	172,469
Turkey	87	15	53,802	173,229
Ukraine	97	15	60,194	193,764
United Kingdom	176	35	373,209	1,175,437
TOT	**1,275**	-	**2,327,441**	**7,341,509**

Table 4 World reachable market for ASSESSTRONIC in 2025.

	Number of institutions	Penetration rate (%)	Reachable turnover first year (€)	Reachable turnover from second year (€)
East Asia & Pacific	3,242	15	3,732,254	11,947,177
Europe & Central Asia	2,082	15	2,265,495	7,251,990
Latin America & Caribbean	734	3	908,644	2,908,626
Middle East & North Africa	377	5	518,933	1,661,137
North America	869	15	1,022,992	3,274,661
South Asia	1,482	3	1,913,127	6,124,038
Sub-Saharan Africa	585	3	889,217	2,846,439
World	9,832	-	11,250,662	36,014,068

5.3 Competition Analysis

Today, the CGA tests are performed by health professionals in old fashion way (on paper) or on electronic format for an automatic recording of the results in the hospital data system. This process is very time consuming and consequently it represents a huge economic burden for the healthy systems.

A lot of applications for mobile and desktop devices proposing questionnaires for cognitive assessment of elderly through CGA standard tests (see Table 5) are available for free. However, these applications are not designed to be used directly by the patients (someone else has to fill the questionnaires) and they don't provide any kind of integration with a medical information network, which means they provide just scores that are not really considerable in a medical context (for diagnosis, following and so on).

For the TUG, several systems have been proposed in the past years by researchers. Mainly they are still laboratory prototypes not ready to be introduced into the market or to be used in healthcare facilities (for this reason they are not listed in the table below). The technology utilized for these systems can be classified in 4 main categories: wearable inertial sensors [1], smartphones [2], ambient technologies [3] and cameras [4]. We refer to [5] [6] for a more detailed literature. The main competitor systems available in the market are the inertial system by Mcroberts and the pressure sensitive mats such as GaitRite® and the Tekscan.

The Mcroberts system consist on a casing containing a tri-axial accelerometer and three orthogonally placed gyroscopes to be attached around the waist of the patient. It can be used to assess the swing during the standing and sitting movements and the gait speed, but it doesn't provide with information about the overall body movements, such us upper-lower body coordination, steps length, single/double support phases duration during gait and so on. Besides, this approach requires that the patient wears the device, which make impossible an autonomous assessment.

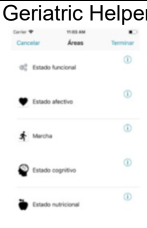
Figure 3 The Mcroberts system

The use of pressure sensitive mats would give very accurate measures on the feet position during the gate, but no information about the upper body movements, for instance, the transition between sitting and standing (and vice versa), the arms oscillation during the walking and so on. Besides, these mats are defined portables, but they are quite big in size and they need to be connected to a processor for data analysis, which would make the set-up process longer and more complex. These systems are also very expensive (for instance the basic version of the Tekscan is about 25000 €).

Figure 4 The GaitRite® (left) and the Tekscan (right) sensitive mats.

In our knowledge it doesn't exist any system conceived for an autonomous assessment of both cognitive and physical capabilities of elderly through CGA standard tests.

Table 5 ASSESSTRONIC system competition table.

Systems	Manual cognitive assessment	Manual physical assessment	Autonomous cognitive assessment	Autonomous physical assessment	Portable	Need of external sensors	Full body analysis	Integration with local IT system	Cost
Indicators of dependence 	✓	×	×	×	✓	×	×	×	Free
Oncoscale 	✓	✓	×	×	✓	✓ (timer)	×	×	Free
Mini Mental state examination 	×	×	✓ (only MMSE)	×	✓	×	×	×	Free
FI-CGA 	✓	✓	×	×	✓	✓ (timer)	×	×	Not on the market
Traditional approach	✓	✓	×	×	✓	✓ (timer)	×	Usually	Very high
Geriatric Helper 	✓	✓	×	×	✓	✓ (timer)	×	✓	Very high
Mcroberts 	×	✓	×	×	✓	✓	×	×	Low
GaitRite® 	×	✓	×	✓	✓	✓ (mat)	×	×	
Tekscan 	×	✓	×	✓	✓	✓ (mat)	×	×	Very high

ASSESSTRONIC 	✓	✓	✓	✓	✓	✓ (box)	✓	✓	Low

6 Business case

For the business case study, the information provided by Doctor Barron from Sant Antoni Abat Hospital, Vilanova i la Geltrú (Barcelona), related to the procedure in this particular hospital has been used. Considering that the test procedure is not very different in other care provider institutions and that in terms of salary costs, Spain is in the middle-low European pay scale, the assumption in terms of payback and saving for hospitals using ASSESSTRONIC solution is quite conservative. In the considered use case the ASSESSTRONIC system configuration used is cognitive + physical assessment modules which represent for the hospital an initial expense of 4,400€ and an annual expense of 900€ from the second year for hosting and support (see Table 6).

Table 6 Average selling price and maintenance price for the basic suggested configuration of ASSESSTRONIC system.

6.1	*Tablet pc*	*Workstation*	*Integration with local IS*
Average selling price (€)	800	3,600	5,300
Average licencing year price (€)	300	600	1,800

6.2 Standard process

The CGA process involves three main activities:

1. the clinical interview
2. the assessment through the standard tests
3. the medical diagnosis

During the interview and the assessment, the health professionals need to gather information from both patients and relatives and some interviews or tests have to be performed separately. The whole process is very time consuming and often the lack of time and resources entails an inaccurate or incomplete assessment.

In the geriatric service of Doctor Barron, Sant Antoni Abat Hospital, for instance, the health professionals can spend with each patient, for the entire CGA, 60 minutes during the first visit and 30 minutes for the following assessments. According to Doctor Barron, the right time required for each activity is approximately:

+ 15-20 minutes for the clinical interview
+ 20-30 minutes for the tests
+ 15-20 minutes for the diagnosis

This means that after the first visit, a proper assessment can't be performed under the time constraints and somehow the CGA process has to be rushed in order to fit within the time scheduled.

Additionally, with this standard procedure, a doctor is involved during the all 3 phases, which means that each CGA process requires **between 50 and 70 minutes** of a doctor time.

In Spain, the average gross salary for a doctor specialist with just 1-2 years of experience is 60000€1, which means that each CGA process costs to the healthcare system around 33€ of doctor salary. In particular, the tests activity costs in average **14€**.

6.3 Procedure using ASSESSTRONIC system

The aim of ASSESSTRONIC system is to assist the medical professional during the CGA process in order to save time both for health professionals and patients/relative and to reduce the costs for the healthcare system (see Tables 7 and 8).

By using ASSESSTRONIC system, the tests activity requires approximately **between 9 and 12 minutes** of a nurse's time, which is less expensive than doctor's time. For instance, in Spain, the average gross annual salary of a nurse is around 24,700€[2], which is 14€ hourly. If a nurse can assist the CGA tests for 4 patients per hour, the tests activity for a patient costs around **3.5€.** The cost of the whole CGA process is 22.5€.

In term of time saving, using ASSESSTRONIC system can help saving in average **15 minutes** per test.

Table 7 Time spent for CGA process using traditional approach VS using ASSESSTRONIC system

	Activity 1 doctor	Activity 2 doctor	Activity 3 doctor	Activity 1 nurse	Activity 2 nurse	Activity 3 nurse	TOT average
Traditional	15'-20'	20'-30'	15'-20'	-	-	-	60'
ASSESSTRONIC	15'-20'	-	15'-20'	-	9'-12'	-	45'

[1] https://www.averagesalarysurvey.com/report/careerprofile/118148
[2] https://www.payscale.com/research/ES/Job=Registered_Nurse_(RN)/Salary

Table 8 CGA process costs using traditional approach VS using ASSESSTRONIC system

	Activity 1 doctor	Activity 2 doctor	Activity 3 doctor	Activity 1 nurse	Activity 2 nurse	Activity 3 nurse	TOT average
Traditional	9.5€	14€	9.5€	-	-	-	33€
ASSESSTRO-NIC	9.5€	-	9.5€	-	3.5€	-	22.5€

In Sant Antoni Abat hospital only 5 CGA processes are performed daily, so in 1 year (52 weeks) the total number of CGA performed is 1300. Using the ASSESSTRONIC system the hospital will spend in terms of salaries 29,250€ instead of 42,900€, which means that **13,650€** are saved annually. This saving is obviously bigger if more tests are performed annually.

In the considered use case the ASSESSTRONIC system configuration used is cognitive + physical assessment modules which represent for the hospital an initial expense of 4,400€ and an annual expense of 900€ from the second year (see Table 6). In less than 2 months, the hospital will have got its investment back. The first year the hospital will save **9,250€**. For the following years the annual saving for the hospital will be **12,750€**.

7 Go-To-Market

7.1 Time line

In Figure 5, the Go-To-Market (GTM) strategy for the 20 months after the end of the product tests is shown.

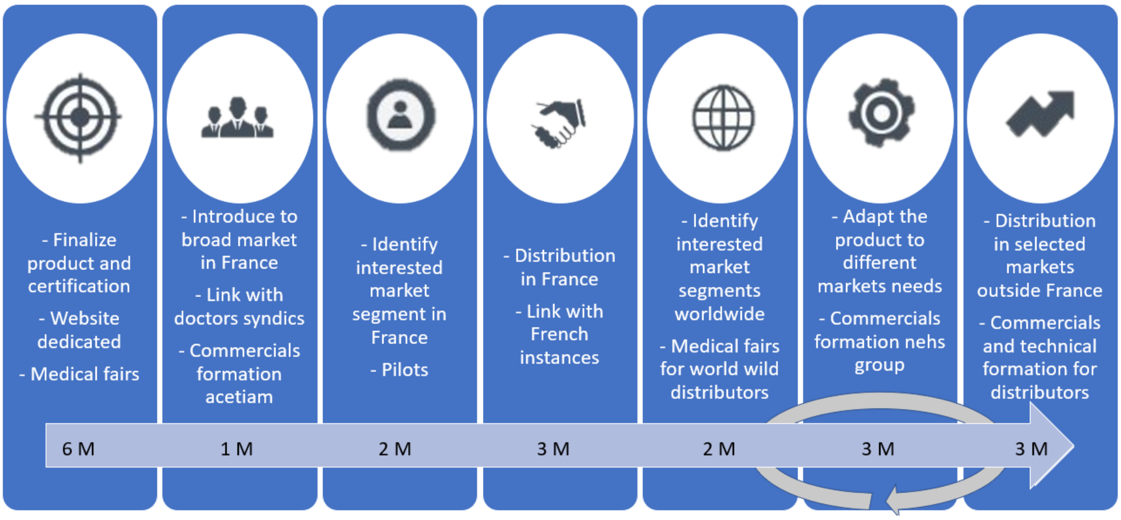


Figure 5 GTM strategy for the next 20 months after the tests ending.

1. The first 6 months will be spent to finalize the product considering the tests result and all the feedbacks collected from the end-users. During this time, the product will be taken from TRL 8 to TRL 9. The certification process will be sorted out.
2. The product will be then broadly introduced to the French healthcare market.
3. The next couple of months will be spent to identify the market segment in France and to establish relation with the costumers.
4. After starting the distribution in France, 3 months will be necessary optimizing the logistic and the production chain and consolidating the costumer support mechanisms with the first costumers.
5. Once the whole chain of production-distribution-support consolidated, it will be the time to expand to another European market segment.
6. The product and the service provided will be adapted to the new explored market considering different needs, legislations (if applicable) and demand.
7. The product will be then distributed in the new market. During the first 3 months the focus will be on consolidating the business with the new costumers and expanding the distribution to other costumers in the same market segment.
8. The steps 5-7 will be repeated to explore new markets (in Europe first and worldwide then).

Figure 6 shows the market maturity chart, with the projection of the revenues and other relevant market indexes. The audience and market expansion will bring a growth in terms of sales and revenues. After a certain degree of maturity reached the price of the solution will be likely reduced, especially for service and maintenance (although, for this BP the price is considered constant for the first 4 years).

An increasing of competition during this process is expected. This issue will be tackled with a continuous effort of improving the system and of adapting the product on regional basis which ensure us a leader and reference position into the market.

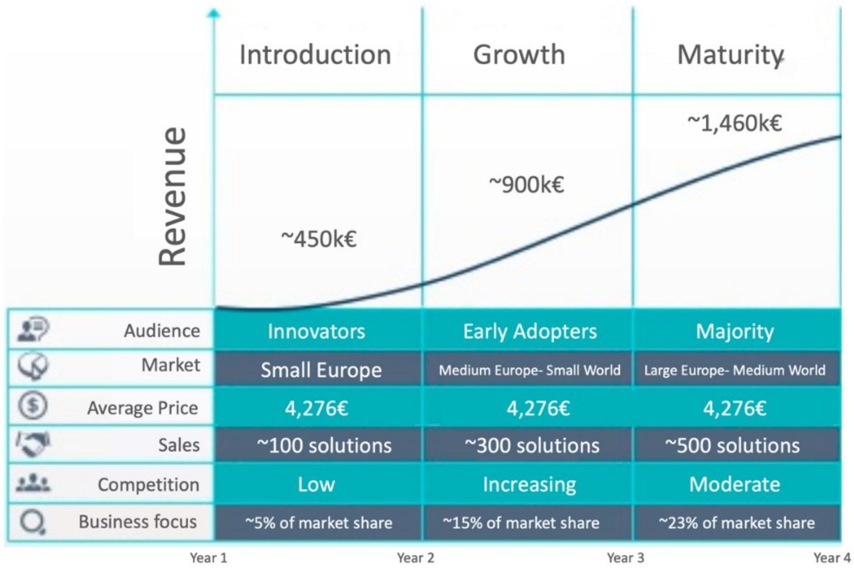


Figure 6 Maturity and growth chart.

7.2 Actions

To promote our solution, different actions will be taken:

+ Website (one website dedicated to ASSESSTRONIC system and web pages referring to it in ACETIAM and UPMC websites)
+ Medical fairs
    - Arab Health
    - Medica
    - MedicAlliance - https://www.medicalliance.global/
        - Medical fair Asia
        - Medical fair China
        - Medical fair India
        - Medical fair Thailand
        - Medical fair Japan

+ Formation of the Acetiam's commercials to propose our solution to the prospect
    - Cross selling with the installed client base
+ To make some pilot (give the solution for some months) in big cities hospitals (with some PhD, the clinical impact and the medical network is better)
+ Link with the instance, and doctor's syndics, organisation of after work to make presentation of the solution

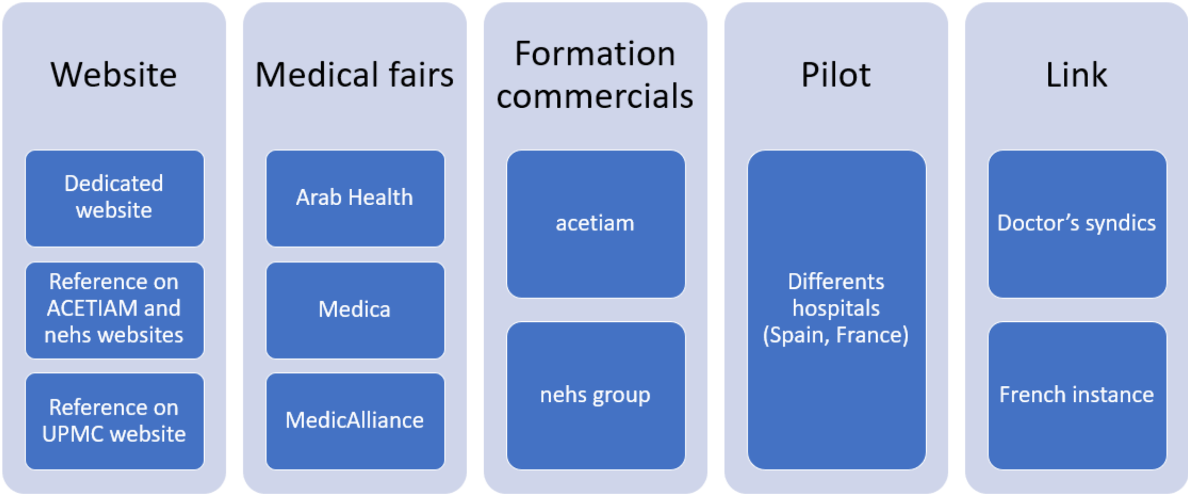


Figure 7 Actions for promotions

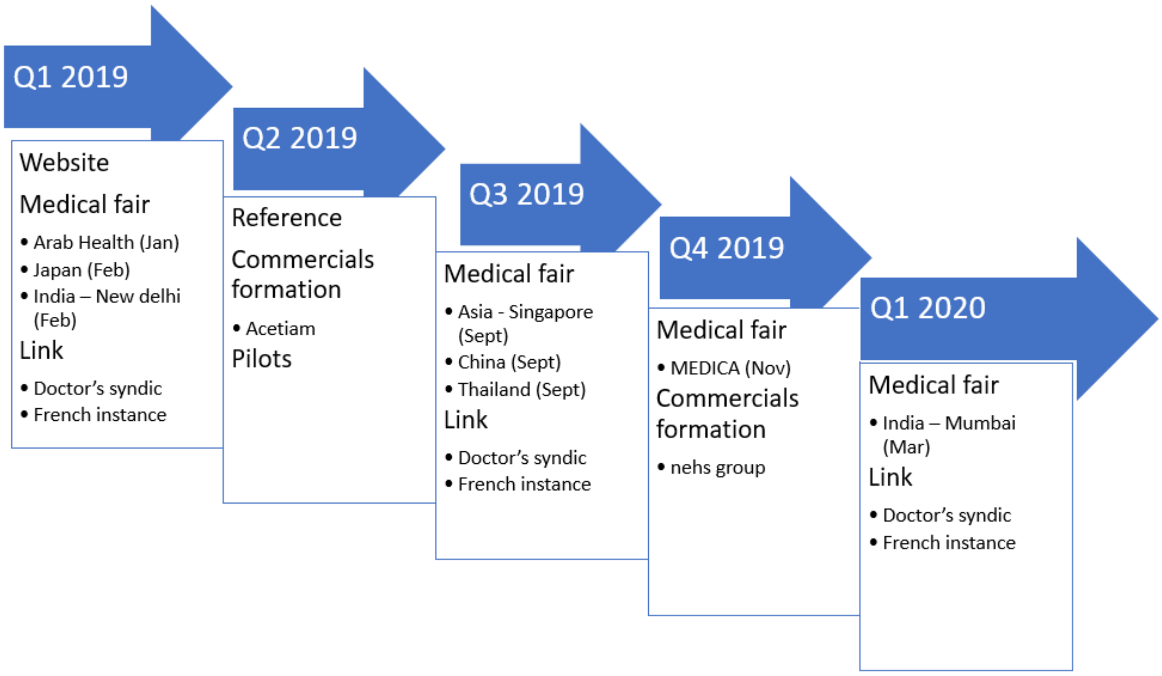


Figure 8 Time line for actions of promotions

8 Organization

8.1 The consortium

Figure 9 The consortium actors

8.1.1 Acetiam

ACETIAM (www.acetiam.eu) is the first European Multispecialty Telemedicine Editor and Operator. The company develops solutions for exams production, collaboration between public and private healthcare facilities, medical images and reports sharing with patients and prescribing doctors.

ACETIAM answer needs of facilities who want to optimize their healthcare resources (human and technical) thanks to a group of services which are integrated in the healthcare pathway. Among those solutions, ACETIAM-Connect Multispecialty telemedicine platform connects more than 500 healthcare facilities with more than 4000 professionals. It puts medical facilities through to specialists (radiologist, neurologist, cardiologist, ophthalmologist, dermatologist…) providing a tele diagnosis (remote diagnosis through ACETIAM-Connect).

ACETIAM solutions are intended to all types of healthcare facilities and answers essential functions of an imaging network:

+ Collaboration through Multispecialty Telemedicine: Secure and structured exchanges thanks to patient cases (Forms integrating the medical Workflow with exams and reports) through Internet
+ Medical imaging diffusion: CD/DVD burning systems, images / patient's booklet printing & Web Diffusion
+ Production and management of all types of medical data (CD/images/videos/documents) through its PACS, MACS, RIS offer;

ACETIAM guarantees its customers that its products and services respect regulatory (CE and FDA) aspects and ensures a quality service. ACETIAM, founded in 1997, keeps growing in France and internationally (Subsidiary in USA). ACETIAM solutions are based on open standards (DICOM, IHE, HL7) of which ACETIAM is one the international recognized actors.

8.1.2 UPMC

UPMC, the largest scientific University in France, has 4.500 researchers and teachers, 180 laboratories, 30.000 students and 700 scientific PhD delivered per year. UPMC is involved in numerous international partnership agreements and has France's largest scientific library and

infrastructures. UPMC European Affairs office, in charge of the EU projects, has managed so far 90 FP7 projects.

Institut des Systèmes Intelligents et de Robotique (ISIR) is a research lab of the UPMC, associated to the Centre National de la Recherche Scientifique (CNRS). ISIR is a multidisciplinary research laboratory, which gathers disciplines of Engineering and Computer Science including mechanics, automation, signal processing, and computer science and Life Sciences (Neuroscience, Psychology).

Researchers from the ISIR lab involved in the project belong to the IMI2S (Integration, Multimodal Interaction and Social Signal) group of INTERACTION research team. IMI2S research group, led by Prof. Mohamed Chetouani, conducts basic and applied research on social signal processing and social robotics. ISIR has setup coherent and competitive infrastructures of technical equipment in order to promote scientific exchange and development of collaborative research works. The project is mainly concerned by the Natural Interaction Platform (headed by Prof. Chetouani).

Relevant previous projects where ISIR has been involved are:

+ MICHELANGELO project (Patient-centric model for remote management, treatment and rehabilitation of autistic children), is a European funded (FP7-257666) research project exploring innovative technologies for assessing and treating the Autistic Spectrum Disorder.
+ SPENCER project (Social situation-aware perception and action for cognitive robots) is a European funded research project (ICT-2011-600877) investigating interactive intelligent systems for navigation and interaction in populated environments.
+ ROMEO2 project (National project within Investissements d’Avenir) is a national project that aims to develop the humanoid robot ROMEO. This project is leaded by Aldebaran Robotics.
+ The SMART Labex project (French state funds managed by the ANR within the Investissements d'Avenir programme under reference ANR-11-IDEX-0004-02)

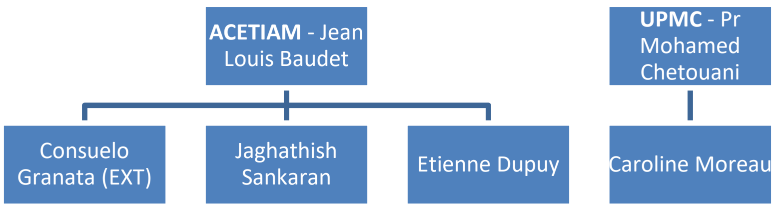
aims globally to enhancing the quality of life in our digital societies by building the foundational bases for facilitating the inclusion of intelligent artifacts in our daily life for service and assistance.

Complementarity of medical, technical and human factors specialists from the know-how point of view as well as from the methodological point of view is necessary from the beginning to the end of a Human-Machine Interaction healthcare project, in order to determine the devices specifications as well as to conduct the user testing, which will bring the product ready or at least very close to the market.

However very few systems in the field of robotic medical assistance have seriously followed such a multidisciplinary approach and to our knowledge none of them has focused on CGA tests. Our multidisciplinary team aims to put together the knowledge of robotic engineers, doctors, computer scientists, psychologists and designers to build a robotic system for CGA assessment with the highest User Experience, technological performance and added value from existing approaches.

8.2 The team

UPMC was more included in clinical protocol and during the prototype tests in Paris. ACETIAM take the development of the solutions, make the pilot tests in Barcelona and manage the project with the help of Blue Ocean Robotics. ACETIAM will commercialised the solution directly for the French market.



To detail the CV of the different actors, here are some more information:

- Jean Louis Baudet

He has more than 25 years of experience in Medical Devices and Healthcare Technologies. He graduated in 1988 with a Master degree in Purchasing from Bordeaux University & Bordeaux Business School. Jean Louis also holds a Master degree in Sciences / Electronics from Bordeaux University. Jean Louis spent 20 years at GE Healthcare with various leadership positions in eBusiness, Marketing, Sourcing, Business Development and Engineering in the fields of Diagnostic X-Ray, Mammography and Cardiovascular. In his last position at GE Healthcare he was in charge of the Global interventional Cardiology segment. Jean Louis is co-author of 3 patents for Digital Mammography. Jean Louis joined ACETIAM in 2009 as Director of Business Development. In this role he led the efforts to build the 4 regional telemedicine platforms that

Accel operates today and worked closely with health professionals to define and implement various collaboration networks including among others: teleradiology, neurology and tele-stroke, neurophysiology, neurosurgery and telemedicine for elderly patients.

+ Consuelo Granata

She received her bachelor in Computer Science and Control from the Università degli Studi dell'Aquila (Italy) in 2006, a M.Eng in Control from the Università degli Studi dell'Aquila in 2007, a M.Sc. in Robotics and Artificial Intelligence from the Université Paul Sabatier (France) in 2008 and a Ph.D. in Robotics at ISIR-UPMC in 2012, from the University Pierre et Marie Curie (France). Her research interests include human-robotics interaction (HRI), personal mobile robots, human detection and decision-making. In particular, she specialized in the field of robotics for elderly with cognitive impairment. In the last years she focused on motion capture and analysis for balance and sensory-motor activity assessment. In October 2012 she has joint the Human Robotics Group at Imperial College as visiting researcher. From 2013 to 2014 she was project leader at CNR-Santé (Nice). She is now project leader at ACETIAM.

+ Jaghathish Sankaran

He received his Master's in Biomedical engineering from Polytech Marseille, Aix-Marseille university (France) in 2003, specialized in healthcare imaging and post processing. Then joined private sector and working more than 15 years in radiology and hospital information system as DICOM/IHE and IT technical expert. He occupied various positions in ACETIAM such as field service engineer, Technical Support Team Leader, CTO, Development Team Manage. He is now working as PACS Product Manager in the Imaging Business Unit.

+ Etienne Dupuy

He is an engineer, master degree in computers and electronics sciences from ESEO (Angers – France), where he graduated in 2010. He worked for 8 years in software editing at Maincare Solutions (Ex-McKesson) as consultant and after project manager for hospital solutions and territories. In the same time, he continued with another master degree, executive time, graduated in 2018, in management and business administration at the IAE, University of Bordeaux (Institute of Administration of Enterprise - France). After this experience and complimentary formation, Etienne decided to join ACETIAM as an account manager in 2018.

+ Pr Mohamed Chetouani

He is the head of the IMI2S (Interaction, Multimodal Integration and Social Signal) research group at the Institute for Intelligent Systems and Robotics (CNRS UMR 7222), University Pierre and Marie Curie-Paris 6. He received the M.S. degree in Robotics and Intelligent Systems from the UPMC, Paris, 2001. He received the PhD degree in Speech Signal Processing from the same university in 2004. In 2005, he was an invited Visiting Research Fellow at the Department of Computer Science and Mathematics of the University of Stirling (UK). Prof. Chetouani was also an invited researcher at the Signal Processing Group of Escola Universitaria Politecnica de Mataro, Barcelona (Spain). He is currently a Full Professor in Signal Processing, Pattern Recognition and Machine Learning at the UPMC. His research activities, carried out at the Institute for Intelligent Systems and Robotics, cover the areas of social signal processing and personal robotics through nonlinear signal processing, feature extraction, pattern classification and machine learning. He is the head of the interdisciplinary research group IMI2S (Interaction, Multimodal Integration and Social Signal) gathering researchers from social signal processing, social robotics, psycho-pathology and neuroscience. He has published numerous research papers including some in high impact journals (Plos One, Biology Letters, Pattern Recognition, IEEE Transactions on Audio, Speech and Language Processing). He is also the co-chairman of the French Working Group on Human-Robots/Systems Interaction (GDR Robotique CNRS) and a Deputy Coordinator of the Topic Group on Natural Interaction with Social Robots (euRobotics). He is the Deputy Director of the Laboratory of Excellence SMART Human/Machine/Human Interactions.

+ Caroline Moreau

She obtained a Ph.D in 2012 in Sciences of the sport, motricity and human movement. From 2011 to 2013, she worked as a full-time research adviser at College of Osteopathy of Champs sur Marnes (France) to help in the creation of the research laboratory. From 2013 to 2017, she worked as a full-time research engineer at rehabilitation service in geriatrics hospital, APHP Pitié Salpetrière Charles Foix to help doctors as to lead their research projects. She is currently project Manager at ISIR Sorbonne University on projects centered on the autonomy of the person in the broad sense. She intervenes on the writing of the experimental protocols, the regulatory obligations, the implementation of the experiment, etc.

9 Financial

9.1 Cost Structure

In Table 9 the selling prices of the different system components and the contribution margins are shown. For the cognitive assessment module, the selling price includes the cost of the application to run on a tablet PC. For the physical assessment module, the selling price include the cost of the hardware (the box with the 3D camera) and the cost of the application to use this hardware. Regarding the integration of ASSESSTRONIC system with the local IT system, this requires a developing work specific for every costumer. This means a massive development effort and, in order to keep the price reasonable for the costumers, a smaller contribution margin is acceptable. These costs represent the expense for the client to buy the solution (it is just one-time expense). In order to use the solution, the costumers have to buy also the support and hosting service every year (Table 10).

Table 9 System selling prices and contribution margins.

	Cognitive assessment system (€)	*Physical assessment system (€)*	*Integration with local IS (€)*
Selling price	500	3000	3500
Hardware cost	0	500	0
Software and installation cost	250	500	2400
Contribution margin (€)	**250**	**2000**	**1100**
Contribution margin (%)	50%	67%	31%

Support and hosting prices include the costs for support/maintenance of the software and for hosting the data. These expenses have to be payed yearly by the costumers to use the system. The contribution margin will be higher than the selling phase because supporting and hosting costs, which are relatively small, have to be afforded just yearly. This allows a yearly affordable expense for costumers as well.

Table 10 Support and hosting prices and contribution margins.

	Cognitive assessment system (€)	*Physical assessment system (€)*	*Integration with local IS (€)*
Support and hosting / year price	300	600	1800
Support and hosting / year costs	30	60	180
Contribution margin (€)	**270**	**540**	**1,620**

Contribution margin (%)	90%	90%	90%

9.2 4-year budget projection

This section summarizes the financial projection for ASSESSTRONIC system. Project expenses and profit have been projected over a four-year span starting from the end of Echord++ project. The financial projection assumes that the number of solutions shown in Table 11 will be sold. Thanks to the modularity of the system the module for cognitive assessment, the module for physical assessment or a combination of both (plus of course the integration of the system with the local IT system) can be sold separately.

Table 11 Expected number of solutions sold in Europe and in the rest of the world during the first 4 years.

	EU				Non-EU		
	Cognitive assessment module	Physical assessment module	Cognitive and physical module	Integration with local IT	Cognitive assessment module	Physical assessment module	Integration with local IT
Year 1	3	25	10	0	0	0	0
Year 2	15	50	10	5	0	3	1
Year 3	30	50	5	10	0	15	5
Year 4	30	50	5	10	0	15	5

Additionally, some licencing through external distributors will be sold (see Table 12). These external distributors will buy the product licenses directly from us and they will take care of reselling them to their client, of supporting and training and of hosting clients' data.

Table 12 Expected number of licensing sold in Europe and in the rest of the world during the first 4 years.

	EU		Non-EU	
	Cognitive assessment module	Physical assessment module	Cognitive Assessment module	Physical assessment module
Year 1	0	0	0	0
Year 2	10	0	0	0
Year 3	12	25	10	25
Year 4	12	25	10	25

Table 13 shows the profits projection considering the contribution margins explained in Tables 9 and 10 and fixed costs of 25% for net profit estimation.

Table 13 Revenues projection for European and world markets in the first 4 years.

	Year 1 (€)	Year 2 (€)	Year 3 (€)	Year 4 (€)	TOT (€)
Cognitive mod EU	2,400	12,900	29,400	38,400	181,500
Physical mod EU	90,000	195,000	225,000	255,000	83,100
Cognitive + physic mod EU	44,000	53,000	40,000	44,500	765,000
IS Integration for EU	0	26,500	62,000	80,000	168,500
Cognitive mod non-EU	0	0	0	0	0
Physical mod non-EU	0	10,800	55,800	64,800	131,400
IS Integration for non-EU	0	5,300	28,300	37,300	70,900
Licensing cognitive mod EU	0	1,500	3,300	5,100	9,900
Licensing physical mod EU	0	3,000	10,500	18,000	31,500
Licensing cognitive mod non-EU	0	0	1,500	3,000	4,500
Licensing physical mod non-EU	0	0	7,500	7,500	15,000
TOT REVENUES	**136,400**	**308,000**	**463,300**	**553,600**	**1,461,300**
CONTRIBUTION MARGIN	**77,452**	**131,992**	**220,012**	**301,282**	**730,738**
Margin - 25% fixed costs	58,089	98,994	165,009	225,961	548,053
Manpower	42,820	15,400	23,165	27,680	109,065
Utilities	1,364	3,080	4,633	5,536	14,613
Logistic and insurance	13,640	30,800	46,330	55,360	146,130
Net profit	**265**	**49,714**	**90,881**	**137,385**	**314,245**

The operating expenses are estimated as

- Manpower (R&D and marketing): 5% of the total revenues
- Utilities: 1% of the total revenues
- Logistic and insurance:10% of the total revenues

For the first year an amount of expenses of 36,000€ of developing costs for product finalization has been added.

ACETIAM is aiming at bringing the product into the market without involving any external investor. This means that ACETIAM will take care of all expenses and will own all the profit coming from the ASSESSTRONIC system distribution.

10 Intellectual Property Rights

The Intellectual property rights are owned by ACETIAM who will cover the proceedings and maintenance costs of IP Protection and all marketing and dissemination actions.

All algorithms, codes, user interfaces and hardware design will be protected.

All the revenues coming from the ASSESSTRONIC solution will belong to ACETIAM excepts for the licensing sold by external distributors. Specific confidentiality agreements (NDA - non-disclosure agreement) will be set between ACETIAM and each external distributor.

11 Risk Overview

Performing a risk analysis of the project, 3 kinds of risks have been found out: technical, commercial and acceptance-wise (see Table 14).

The technical risks are related to the nature of the research itself: it is ambitious to integrate on the system functionalities that are innovative, but at the same time reliable and accurate. For instance, the technical challenges to be solved or at least faced are: inaccuracy of the human body tracking and activity analysis and of voice recognition especially in noisy environments; also, privacy issues for private medical data storage and management have to be considered. However, the teams involved on the project have been selected because of their skills, experience and reputation. The composition of the consortium makes all the technical risks totally acceptable and manageable. Having to react about this, some modifications on the software and to make an update of the version seems necessary. The approach will be to change the design and co-develop with the pilots on the 6 first months.

The obvious commercial risk of the system is the high price. It is why the approach is to be engaged to work on reliable and functional algorithms by using only low-cost technologies (3D cameras and commercial tablet PC) in order to bound, as much as possible, the hardware costs. The cost of a complete solution (cognitive assessment + physical assessment + integration of the system with the local IT) will be less than €10k first year and less than €3k afterwards, which is completely acceptable. While the expectation is to save some administrative time of a doctor, some people would say that it changes the human share with the patients. A metrics on this advantage can be found and it can be transformed in success cases.

The acceptance risk comes from the non-acceptance of the system from the patients. If there is no doubt that the medical personnel would accept the use of such a system because this entails a gain in term of time and accuracy for CGA, the patients could be annoyed for interacting with a machine. But, analysing this risk with some geriatric doctors, it has been pointed out that sometimes the patients feel discomfort and the weight of the judgment in interacting with medical staff. The experts suggested that the interaction with a machine is sensed as neutral and not judgmental, which has a positive impact on the exactness of the results. In case of non or poor acceptance, the interfaces of the system have to be improved in order to enhance the usability of the system by a specific population.

Table 14 Risks overview and mitigation strategies.

Risk	Description	Mitigation strategy
Technical	*System based on challenging and innovative functionalities such as body tracking and movements analysis.*	*After the tests, 6 months have been scheduled to make changes to the hardware and improve the software. The technical experience and the academic excellence of the consortium guarantee a potential exploitation of a huge range of alternatives to the current solution element if needed.*
Commercial	*System unaffordable for medical centres and hospitals.*	*The system is composed of all low-cost elements and so its price is largely acceptable. If replacing part of the hardware to improve the performance of the system is necessary, it will be done considering the price constraints in order to keep it low-cost.*
Acceptance	*Non-acceptance of the system by elderly patients because of lack of experience in using technology.*	*The interface of the system can be improved in order to enhance the usability of the system by a specific population. The needed changes will be carefully discussed with health professionals and involved patients.*

12 Bibliography

[1] L. P. Fried and e. al., “Frailty in older adults: evidence for a phenotype,” *J Gerontol A Biol Sci Med Sci,* no. 56(3):146-56, 2001.

[2] R. C. and T. B., “Plusieurs centaines de milliers de chutes chez les personnes âgées chaque année en France,” in *Revue d'Epidémiologie et de Santé Publique. Institut de veille sanitaire*, Saint-Maurice, France, 2008.

[3] K. Rockwood, K. Stadnyk, C. MacKnigh and e. al., “A brief clinical instrument to classify frailty in elderly people,” 353 : 205–6, 1999.

[4] T. Gill, E. Gahbauer, L. Han and H. and Allore, “The relationship between intervening hospitalizations and transitions between frailty states,” *J Gerontol A Biol Sci Med Sci,* no. 66(11) : 1238-43, 2011.

[5] J. Subra, S. Gillette-Guyonnet, M. Cesari, S. Oustric and B. Vellas, “The integration of frailty into the clinical practice: preliminary results from the Gérontopôle of Toulouse, France,” *The journal of nutrition, health & aging,* no. 16(8) : 714-720, 2012.

[6] L. Rubenstein, “An overview of comprehensive geriatric assessment: rationale, history, program models, basic component,” *Rubenstein LZ, Wieland D, Bernabei R, editors. Geriatric assessment technology: The state of the art,* no. Springers, 1995.

[7] B. D. Mahoney F.I., “Functional evaluation: The Barthel Index.,” *Maryland State Medical Journal,* no. 14 : 56-61., 1965.

[8] A. Al-Jawad, M. R. Adame, M. Romanovas, M. Hobert, W. Maetzler, M. Traechtler, K. Moeller and Y. Manoli, “Using multi-dimensional dynamic time warping for TUG Testinstrumentation with inertial sensors,” in *IEEE International Conference on Multisensor Fusion and Integration for Intelligent Systems (MFI)*, Hamburg, Germany, 2012.

[9] P. Madhushri, A. Dzhagaryan, E. Jovanov and A. Milenkovic, An mHealth Tool Suite for Mobility Assessment., Information, 2016.

[10] T. Frenken, M. Lipprandt, M. Brell, M. Govercin, S. Wegel, E. Steinhagen-Thiessen and A. Hein, “Novel approach to unsupervised mobility assessment tests: Field trial for aTUG,” in *International Conference on Pervasive Computing Technologies for Healthcare* , 2012.

[11] N. Kitsunezaki, E. Adachi, T. Masuda and M. J., “Kinect applications for the physical rehabilitation,” in *Medical Measurements and Applications Proceedings (MeMeA)*, 2013.

[12] G. Sprint, D. J. Cook and D. L. Weeks, “Toward automating clinical assessments: A survey of the timed up and go,” *IEEE reviews in biomedical engineering,* vol. 8, pp. 64-77, 2015.

[13] T. Li, J. Chen, C. Hu, Y. Ma, Z. Wu, W. Wan, Y. Huang and e. al., “Automatic Timed Up-and-Go Sub-task Segmentation for Parkinson’s Disease Patients Using Video Based Activity Classification,” 2018.