THE INTERNET OF THINGS (IOT) IN LEBANON

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ABSTRACT:

In the Internet of Things (IoT) world, everything that could be connected will be connected. Ericsson and CISCO, predict that there will be 30 billion connected devices by 2021. Business experts estimate that around $6 trillion will be spent on IoT solution over the next 5 years. IoT creates new products and services, makes daily human life better, safer and reduces largely actual health and energy bills. Although the IoT has become a reality in many developed countries, there is no governmental plan in Lebanon where the research will be carried out by applying SEAM methodology. The objective is twofold: First, increase awareness and expertise in IoT among professionals and undergraduate students. Second, study the sustainability of IoT startup companies in Lebanon.

Keywords: IoT, SEAM, Lebanon, universities, startup.

INTRODUCTION

Drones being used to collect items from retailers; A car pilot playing card with the co-pilot in a driverless car; Room light and TV switching off when the viewer falls asleep; A traffic light that changes from red to green at the approach of an ambulance; A smart medicine bottle tap that reminds the patient in case he forgot to take the medicine at the right schedule etc... These are only few examples of the IoT (Internet of things) domain where everything that could be connected will be connected. Ericsson, the leader in Telecommunications, predicts that around 30 billion devices will be connected by 2021 [1]. Business Insider analysts [2] predict that nearly $6 trillion will be spent on IoT solutions over the next 5 years. The impact of IoT does not only create new products and services but it also reduces the cost of productivity and reduces health bills and energy consumption. For example, driverless cars operation in the US market alone could save $488 billion by preventing accident costs and $158 billion in fuel cost savings [3].

In developed countries, many companies, whether big (i.e. Samsung) or small (i.e. GlowCaps for medicine tap reminder example above), have already started to sell or test new IoT products in different sectors. However, in many developing countries, apart from few IoT projects presented at some universities,

the subject is new and there is no national plan to motivate the young generation to acquire IoT skills or to encourage local companies to implement IoT solutions. View the importance of IoT and the actual situation in developing countries, especially in Lebanon, one objective of this research is to create an IoT awareness at all levels of the society from undergraduate up to graduated engineers. Another objective is to reflect the actual dysfunctions that are blocking the creation of IoT startup company.

Before going into problem statement and research objectives, following is a brief description of an IoT network: In its most simple way, it is composed, as shown in Figure 1, of one sensor which could be implemented anywhere, of a gateway and of a data center. Different types of sensors (air temperature, humidity, human heartbeat etc..) collect different types of information. The data center is built out of large computers where the data from all sensors arrive in order to be analyzed and an action is taken. Between the sensor and the data center is a gateway device. This is needed because with actual wireless technology the maximum distance that a sensor could reach is 35 km. Therefore, the gateway receives the wireless data and forwards it, via i.e. the internet, to the remote data center which could be located thousands of km away from the sensor, in the same country or in a remote one.

Figure 1: The architecture of an IoT system

It should be noted that IoT is still a new technology and there are many issues to be solved before being fully exploited. Below are some main concerns and methods to overcome them:

• Privacy and security are of the main concerns of IoT. As an example of privacy, millions of wearables (i.e. watches, clothes etc…) send their data about patients for example (heartbeat rate, level of glucose etc..), via the cloud to a remote server where these data are analyzed. But what if these data are hacked? Another example of security is smart electricity grid line where millions of interconnected IoT devices are controlling millions of houses, if one could hack one device on the grid he/she might have access to all other devices on the same grid and switch off the energy on millions of houses.
• There is a need for an IoT wireless infrastructure that could communicate with distant sensors that consume low transmission power in order to save the

device battery consumption (in IoT the end device is expected to have a multi-year battery life). For instance, different wireless providers such as SigFox [4] etc... are developing wireless standards and equipment for that purpose.

•   Lack of interoperability between sensors from two different vendors as well as between sensors and remote machines (gateway and data center). Actually different devices from different vendors send their data in different formats. This could be solved by standardizing the format of data exchanged between sensors and remote server. Actually one company Evrythng [5] propose solution for IoT interoperability.

•   Another main concern of IoT is who owns the data? Information coming from all types of sensors (from eHealth wearable, retailers, cars, manufacturers, farms etc…) will be stored on the 'Big data' server. For instance, a retailer's smart tags (sensors) are embedded in all products (on Pepsi can, on sugar bag, on the bottle of milk etc…). The problem will arise in case the owner of 'Big data' sell the information of one retailer A, to another retailer B, without the knowledge of retailer A. By accessing that information, retailer B could recognize the identity and the quantity of each sold item together with date and time of their sale.

In this research IoT companies are divided into seven categories.

- •   First category: *Retailer*
  Each day new IoT products are delivered to the market. A first category of IoT companies consist of standard retailers who buy IoT products (i.e. smart wearables) from the manufacturers and sell them, with some profit margin, in the local market. For this type of companies, technical skills are not a prerequisite; however, choosing the appropriate geographical area of the shop and the having enough funding are the key of success.
- •   Second category: *Maintenance company*
  With the drastic spread of IoT products into the market (in manufacturing, in cars, in elevators etc…), it is essential to provide these products with the needed maintenance when they get faulty. In order to provide this service, there should be specialized companies which key of success is to have the right maintenance tools, but more importantly the right technicians.
- •   Third category: *Data centers*
  The more sensors and devices are implemented, the more and bigger servers are needed. Data centers consist of one or more room(s)/building(s) which host these servers that consist of computers with low or high performance. Millions and even billions of IoT devices are expected to run in parallel. This will generate a huge amount of information to be received at the data centers and the procedure that is used to analyze the received data is called 'Big Data' analysis.
- •   Fourth category: *Complex machines*
  This includes driverless cars, advanced robotics, IoT devices used in airplanes and manufactories and others.
- •   Fifth category: *Mass production of low cost sensors and electronic devices*

This includes all types of sensors (temperature, humidity etc…) note that the cost of such sensors which are mostly fabricated in China is very little.

- Sixth category: *Customized solutions*
  This consists of introducing new solutions to the market i.e. in one example by inserting a sunlight sensor on a curtain, when the sun appears the curtain goes down and when it disappears the curtain goes up. In another example, if we put a moisture sensor in a garden and connect it to both an irrigation system and to a weather database, the irrigation system will not be activated if rain is predicted.

- Seventh category: *Services*
  By inserting sensors everywhere and making them send their information to a database, then new type of services/companies arise which consist of 'pay as you use' and that is one of the advantages of IoT. For example, by inserting in a car some sensors that report the speed and the distance travelled by a car, an insurance company could customize the price for each driver depending on these reported data.

PROBLEM STATEMENT

In Lebanon, we assume that the same applies in many other developing countries (in Africa, Latin America, Asia, etc…), not all types of IoT companies mentioned above could be applied. This is due to several reasons:

- Minor or total absence of governmental strategy and investment, not only in IoT which is new but also in many other fields;
- Foreign investors are reluctant to invest on a large scale in such countries due to political and social instability;
- Lack of competent people in the new IoT field;
- Inadequate infrastructure;
- Lack of experience in manufacturing.

As a result, building complex machines like a driverless car or 'Big data' servers in Lebanon might not be a sustainable business. However, there are a lot of opportunities in the other categories such as maintenance or customized solution or services.

Actually, the IoT has the following big advantages that should encourage engineers to establish their startup companies:

- The market is still virgin. Sensors are not yet everywhere.
- One could insert a sensor in any place (in a curtain, on a door, in the fridge, in the shoes, in a car etc..), get the data from those sensors and then build a solution based on that data (i.e. if the received data exceed a threshold a predefined action is taken).
- Only very few thousands of dollars are needed to build a solution. In fact, to build one solution, one could buy a sensor for few dollars (less than five), connect it to a gateway (usually a Raspberry Pi or Arduino modules which one could buy for less than $100) then rent a database

in the cloud for few hundred dollars from any cloud provider like Amazon or Microsoft or Verizon or Salesforce etc…

Some of the facilities found in Lebanon that might encourage the establishment of a startup company are:
- Affordable registration fees (around $1000) of a new company without delay in paper completion.
- Good educational level at the majority of local universities.
- The increase of funding companies in the last three years (many local and foreign Venture capital companies as well as private banks and moreover the Bank of Lebanon) who are eager to support new startup companies.

Despite the facilities mentioned above, it was observed that the number of IoT companies is very small and the existing ones lack innovation and good quality of the final product. This is due to the following issues:
- The migration of 'top' graduated students either to continue their study (Master and Doctorate degrees usually in Europe or USA) or to work abroad for big companies with a higher salary and for a better career path. Therefore, what is left is less competent engineers. This issue is also faced in many developing countries and especially in India. For instance, the number of the engineers graduated from the prestigious IIT (India Institute of Technology) that leave India towards the USA is unbelievable (more than 90%).
- International companies like Ericsson, Microsoft, Intel, Cisco etc.. are present in most countries and they pay higher salaries to what is given for technical engineers in local startup companies. As a result, top engineers prefer working with big companies and grow with them, accessing top worldwide technology and benefiting from higher salary than taking the risk of going with local startup companies where the chance of continuity is smaller and the salaries are much less.
- The lack of expertise in the IoT domain. As the subject is still new, there is a lack of expertise in the local market. Even though with IoT many 'low level' jobs will disappear, there will still be a global need for a more sophisticated jobs that require high level of education. In fact, even in the developed countries, there is a lack of 'Big Data' analysts who should have good background in mathematics (interpret statistics and all type of graphs representing the trend of the information coming from millions of devices). This could be an opportunity for universities in developing countries to include this type of specialization in their programs.
- The lack of the needed managerial skills and strategic plans which help maintain the business sustainability in IoT startup companies. This is due to the fact that these companies are made up of few members (less than five) in order to reduce costs where the focus of each person's may be more on the daily activities.
- The lack of advanced courses in IoT hardware design and solutions setup, especially in Lebanon. To establish a software company, one needs a computer and knowledge in software programming. However,

with IoT the majority of the solutions require knowledge in both software and hardware. Whereas the majority of universities worldwide, including the ones in Lebanon, provide many advanced courses in software programming, there is a lack of advanced courses in IoT hardware design and solutions setup.

- Once an IoT solution is built, the design and the manufactry of the hardware is usually done in China because of the low cost and the expertise being provided there. The problem is that actually finding the right company that could deliver the requested component in the fastest way is not a straight forward procedure.

- There is actually a lack of business courses at the engineering departments that could advise the future entrepreneurship on how to establish a sustainable business. This is because startup companies are usually built by fresh graduated engineers focusing more on the short term return revenue rather than on building a long term strategy.

- A well-known problem in Lebanon is what is called 'the neighbor imitation' where people try to copy each other in business. Therefore, if one build any successful business, an IT company or a pharmacy or a cafeteria he should expect someone to do the same business more often in the same area. So it is very important to be first in this small market and get as much share of it as possible.

- With the disappearance of the middle classes in the Lebanese society in the recent years, due to the inflation, there might be little market for these new smart products i.e a smart curtain or a smart door etc…, which could be classified as a luxury to have. In fact, with the actual economic situation the consumer would prefer to leave his/her little savings for priorities rather than spending it on luxury items.

- There is a cultural inheritance that says that all what is made in the Western world is good whereas any local product is missing good quality. As a consequence, when a Lebanese customer is faced in front of two similar products: one that is made in the western world and another one that is made locally he would then prefer the foreign one. Such attitude is not valid only towards technological devices and machines but also towards food products and many other products. As a result, any new IoT product made locally will face the same cultural objection and customers would prefer to buy any similar foreign product even at higher price.

- Lebanon is a small market. The actual population living in the country is around three million and a half with around two million and a half Syrians refugees. On top of that, its geographical area which is also small: 10 452 km2. The vast majority of the refugees are living in camps or renting apartments and they are not IoT clients. Moreover, not only Syrians refugees could not be IoT customers but also the majority of the Lebanese and this is due to the economic crisis which made most of the Lebanese middle class reluctant to spend on IoT products which is still considered as luxury ones. This is a major obstacle to the sustainability of any new IoT startup company in Lebanon. However, in big countries such as China, India or USA where the market is much

bigger, any startup company will have more chances to survive than in any other small country.

- So one available solution is not to target the individuals but rather the government by proposing what is known as smart cities. In fact, many countries have already started to build or at least to plan for smart cities which consists of inserting all over the city different types of IoT sensors and devices: smart cameras, smart light sensors, pollution sensors, water and electricity smart metering, smart parking etc…. Even though smart cities would reduce the energy bill (electricity, water, fuel etc..), make the city safer (smart cameras) and bring tens of new IoT companies and hundreds if not thousands of new jobs, in Lebanon such projects are very difficult, not to say impossible to be implemented. In general, all projects that are at municipal level and beyond (governmental) are usually carried by a certain political group and they turn down any project which is not of any benefit for them or if it does not reflect the political party that support their campaign and this can be a disadvantage for many startup projects. In one example, smart electricity metering was proposed to the government three years ago but that project has never been implemented even though it would reduce a lot the electric bill. We should note here that in Lebanon the annual losses coming from the electricity sector are two billion dollars since in the last few years and they are considered to be the biggest losses of the government. Even though politicians are aware of the solutions for the actual electrical issue i.e. by implementing new solar or wind or fuel stations etc… nothing has been done so far.

AIMS

The drastic development of technology and the implementation of IoT in international companies such as Verizon, CISCO, IBM and Ericsson where I am currently a senior engineer raised my awareness to the importance of IoT to the future of my career.

Moreover, I have been teaching a wireless course for 5 years sponsored by Ericsson (about 3G, 4G, an introduction to 5G and IoT) at INCI institute (part of Saint Joseph University). So my involvement in the IoT field is not completely new and is going to be a part of my future focus.

Note that my intervention will not be carried out at my actual company Ericsson but rather at small size IoT startup companies.

HYPOTHESIS

Core Hypothesis:
- An important factor for the success of any new startup company is to have undergone through an efficient preparation phase before launching any new product. In other words, that is building the company on a solid ground.

Descriptive Hypothesis:

- Actual IoT startup companies in Lebanon are lacking quality and innovation in their products.

Explicative Hypothesis:

- There is a shortage of expertise in the IoT domain.
- In order to save costs and get a quicker revenue, the owners do not spend enough time in investing in the preparation phase.

Prescriptive Hypothesis

- Investing more in some intangible factors during the preparation phase will lead to a better quality of the final product and to a more sustainable company.
  Example of these factors are: The level of technical expertise, the research on existing products, the efficient distribution of responsibilities etc….,.

RESEARCH FIELD

The research will be carried out in Lebanon and it is divided into three fields:

- First field: Two different types of IoT startup companies. One that sell an IoT hardware and another one that has built a 'Big data' server.

- Second field: I will do an intervention at one university in Lebanon.

- Third field: Create IoT knowledge awareness through IoT organized events or via the media.

No intervention yet done. I am planning to run the intervention by mid-June.

RESEARCH METHOD

In my research I will apply SEAM [6] intervention as follows:

Horivert (Horizontal & Vertical) diagnosis to be applied at the startup companies and at the university in order to reveal all the dysfunctions. This consists of a face to face interview.

SEAM tools like The '*Internal/External Strategic Action Plan*'; '*Priority Action Plan*'; '*Time Management*' and '*The Competency Grid*' are very useful especially for startup companies where, due to lack of resources, each member of the startup might be doing more than one activity and hence losing efficiency and losing focus on the company strategy.

RESEARCH QUESTIONS

For Universities:
1. What is the level of IoT courses (software and hardware) delivered at universities?
2. How many IoT teaching hours are there?
3. What is the percentage of the university budget allocated for IoT?

4. What are the IoT lab status and how much funding do they receive?
5. What is the nature of IoT projects for end year projects?
6. What is the number of students enrolled in open platforms i.e. coursera? and are these courses accredited?

For the IoT startup companies:
1. Are IoT startup companies targeting local market only, regional or International?
2. Was it easy/difficult to recruit technical experts in IoT?
3. Was the company funded via the founders savings or via credit from the bank or from a Venture Capital company?
4. Will the product be launched after all its features being built? Or a strategy of launching the product with MVP (Minimum Viable Product) will be used?
5. Are there any local/regional competitors in the field?
6. Will the hardware be produced locally or abroad (China or others)?
7. Will the company rent an online server in the cloud from big companies like Amazon, Intel or Verizon etc… or will they rent/build a local server?
8. What is the salary given to the technical engineers in the startup company?

RESEARCH OBJECTIVES

The SEAM methodology will be used in all my interventions and the outcome is threefold:

- For the IoT startup companies as the number of members is very small I will do the intervention (Horivert) with all the members.
- At the university: I will do the intervention with the head of the hardware lab who is usually responsible for any IoT projects performed by the student. It would also be useful to perform the interview with at least two students of the final year (who do not plan to continue their study but go for employment).
- Public policy and increase IoT awareness about the importance of the IoT.

As these are two different sectors, I can run the intervention in parallel in both places.

For the university part: The report including all dysfunctions and expert observations will be announced not only to the group on which the intervention was performed but also maybe in front of the Dean of the computer and communication department in addition to the students and the head of the hardware lab.

For the startup company: Time is very critical in any startup company: the more delay in launching the product might be catastrophic as another competitor might launch earlier a similar product and hence seize the market first, also as the

budget is usually limited any delay in the production might be at the expense of the budget booked for other purpose like marketing or other.

For the public, this could be done via IoT competition targeting students at universities. The organizers should include big operators in the country as well as some governmental members i.e. the minister of telecommunications or one of his representatives.

One of the added value of this research is to be among the first, at least in Lebanon where the research will take place, to trigger IoT awareness at a country level.

BIBLIOGRAPHY AND POSITIONING

Many countries have already launched IoT programs: In March 2010, the Chinese government launched a national R&D center devoted to IoT [7]. In 2011, Germany launched 'Industrie 4.0' program which aims to improve its manufacturing competitiveness by investing heavily in IoT. In 2015 a group of academics and economists in Finland [8] urge their government to launch IoT programs like the ones in Germany and China and have given many recommendations including IoT educational program (at universities). In January 2016, the Prime Minister of India launched "Start-up India" initiative with the objective of transforming India from a nation of job seekers to a nation for job creators. Part of the Prime Minister plan is to train 400 million people 'digital skills by 2022 [9]. However, in Lebanon with the absence of governmental program, IoT initiatives is still confined to few individuals only. In addition to the government, a good initiative might come from local operators for different reasons: All IoT communications should pass by the networks and they have the technical expertise and the necessary funding. In fact big operators (Orange [9] in France and Verizon in USA [10]) have already established many tools and programs in IoT, however in Lebanon the two existing operators Alfa [11] and Touch [12] have not started on any IoT activity yet.

View the importance of IoT, few universities in the developed world have already started delivering courses on IoT [13]. Such courses are not only dedicated to registered students but they are also offered online for non-registered students. Actually these courses are available to anyone for free on some popular educational platform i.e. Coursera [14] and FutureLearn [15]. The duration of such courses range from few days to few weeks and actually the number of registered learners in these courses is about twenty thousand with excellent feedback. In addition, some institutions deliver online courses against a fee i.e. 'Internet of Things: Roadmap to a Connected World' course is given by MIT (Massachusetts Institute of Technology) Professional Education [16]. The cost of the course is for $495 and the duration is for six weeks. Moreover, some known technical communities or companies do offer good information about IoT like IEEE (Institute of Electrical and Electronics Engineers) forum [17] which is usually visited by all electrical and computer engineers all over the world. There are also many other good IoT sources of information on the internet like www.oreilly.com and www.postscapes.com to list few of them.

In 'Collaborative Internet of Things' [18], in addition to giving a full description of all the components of an IoT network, different examples of how one can go with any IoT idea from one level to another are described. For instance, in a smart irrigation system not only a moisture sensor is used, but the input of other sensors is also considered, i.e. when the plant is 'thirsty' (level of moisture is below a threshold), the irrigation system controller will not water it if rain is predicted after few hours. Moreover, the system will measure the quantity of water consumed per day or week etc…

A famous IoT product is Nest thermostat developed by Nest company which was founded in 2010 and sold in January 2014 to Google for $3.2 Billion [19]. The added values of that thermostat where many sensors (of temperature, humidity, light etc..) are embedded, reside not only in its several smart functionalities but also in its practicality to its users because it can adjust its output based on the data received from the sensors. Moreover, as it contributes to the reduction of the electrical bill consumption for each consumer, in each region Nest company could make a business agreement with that region electricity provider as it did in Texas, USA with Austin Energy utility [20].

Another example of IoT business models is the smart toothbrush by Oral-B which perform many functions: It reminds the user to brush his/her teeth during the day, it uses pressure sensors to tell the user how hard he/she is brushing his/her teeth, it tracks the progress over time with charts. By linking that smart-toothbrush to a database, innovative business models [21] are created: a free game application is given for any child who brushes his/her teeth twice per day as a reward, a dental insurance contract is tailored depending on the brushing activity of each smart brush user.

Furthermore, 'Operating in Emerging Markets' [22] is an excellent reference to those who want to create any new business in a developing country, including Lebanon. It gives, among others, an example of how local researchers from General Electric in Bangalore India, stripped the original device that performs electrocardiograms (ECGs) from all nonessentials functions and components i.e. remove large screens and mechanical components needed to produce a large printout of the ECG, and they created a product that is lighter and cheaper and could be sold in the local market. From this example one could think of having customized IoT machines and devices dedicated for developing countries.

For what concerns data centers, which is mentioned in the general introduction of this document as a third category of IoT companies, according to a study conducted by Copenhagen's Economics [23] Google has invested 900 million euros from 2007 to 2014 in order to build two data centers in Belgium. These facilities have created around 1500, direct and indirect, employment per year. That is why based on the above example and on other examples in existing literature, it is very encouraging to have data centers being built in the developing countries as they create new jobs and bring external investments to the local economy.

Protecting any new technological solutions, including IoT, via Intellectual Property might be another source of income. For example, few months ago, Softbank which is a Japanese mobile communication operator acquired a British chip designer ARM Holdings Plc for a large amount of $32 billion [24]. Note that ARM does not make semiconductors, it just develops the technology and licenses it to others. In other words, ARM does not have plant facilities and equipment but rather its assets are in the intellectual property.

Privacy and Security are one of the biggest issues of IoT [25]. Imagine that a hacker succeeds in accessing the system that is running on a driverless car or in a hospital etc.… The result will be catastrophic. In order to avoid such scenario, IoT vendors already started developing very simple sensors with 'read only' capability [26] in order to prevent any access to the sensor. However, even though the end device, that is the sensor, is protected from being manipulated, the hackers could attack any other part of the network i.e. the gateway or the data center.

Time is not only important for startup companies but it is also essential for the existing ones. In fact, they might find themselves beaten by unknown IoT startup, if they delay to introduce IoT devices to their machinery [27].

In the bestseller 'Zero to One' [28], the main message is that in order to succeed in a business (a new startup company) one need to avoid competition and rather build a monopoly. There are few recommendations mentioned in the book that help a company succeed in building a monopoly: One of them is to have a product that is at least 10 times better than the one available at any other competitor. For example, Google could create a monopoly because its patented research engines is 10 times faster and more accurate than the ones used by any other search companies. Another advice is to start the company focusing on a small group that might adopt the product then scale up rather than going from day one targeting the biggest number of customers. An interesting remark mentioned in that book is that the value of a startup company is not based on its actual profit but on how much it could generate cash flows in the future. This is accompanied with the example of Twitter and New York Times Company as follows: 'When Twitter went in public in 2013 it was valued $24 billion more than 12 times the Time's market capitalization even though the Times earned $133 million in 2012 while Twitter lost money'.

In the best seller 'The Lean Startup' by Eric Ries [29], the main idea is as follows: do not wait till your product has all features built in because the customer might not like it and hence all your work, time and money will be wasted. Rather prepare a MVP (Minimum Viable Product) and then based on feedback from customers, which should be taken as a learning experience, try to add new features or optimize existing ones. Based on such experiments the startup company could pivot as soon as possible, with minimum losses, to whether preserve the original strategy or change to a new different one. In order to preserve or change strategy one should look at two important factors: Value hypotheses (number of customers using the product) and growth hypotheses (rate of the increase of new adopters).

A standard existing IT company might have one part of its product being built by its own staff, i.e. the design and the software, and another part can be built by a remote company, i.e. the hardware can be made in China. However, the final product with all its data is owned by that IT company. Whereas, in IoT, the situation is different. The data collected from the sensors is sent to a remote server usually owned by another company which could be located in the same or in another country. The problem is not by the data being sent and treated by another company, but it is in the 'potential' services that might arise from these data. For example, an IoT company has the role of selling and maintaining an IoT sensor to be inserted inside the car to collect different types of information i.e. mileage, average speed, brakes expiration period, engine alarms etc…. Different service companies might be setup based on the car data received by the remote server: In one example, based on the mileage information a car insurance company might sell its insurance for less money for the driver who travels less and drives safely. Furthermore, if the brakes have an electronic identity, we will be able to find out the life period of that type of brake through the collected brake information and such data could be sold to a brake company. It should be noted that with IoT, two or more companies, owned and managed by two different staff, totally depend on each other. In the car example above, one company produce the car sensor, i.e. it develops, sells and maintain that hardware, whereas a totally different company which is ran by a different owner and managed by a different staff might be issuing the car insurance contracts. If the first company does not manage to sell its hardware, the second company might not have enough customers to sustain. Similarly, if car insurance companies do not offer attracting insurance contracts then the device that collects the car mileage will not have an additional value. In other words, any dysfunction such as production gap or staff absenteeism in one company can lead to an immediate dysfunction in another company. The problem is that usually the 'dysfunction' will not be limited to only two companies but even to more. In fact, if the owner of the data who is also the owner of remote servers increase the cost of the collected data, the price of the insurance policy will be affected immediately because this may lead to a decrease in the selling price of the car devices. As a consequence, IoT brings new type of businesses not experienced before. This is a field not only new in the developing countries but it is also new in the developed world. In my case, as mentioned before I will apply SEAM intervention. Based on SEAM database and based on the logic behind the SEAM, it is certain that such method will bring its benefit to any startup company whether it is IoT or not. However, as the type of company is IoT which is different from existing standard comapny, maybe a new method or approach might be added to existing ones. Only the field experience would tell. The results will be added to existing literature and in case good results are found the objective is to apply the same approach in other countries similar to Lebanon like African countries or some Latin American countries.

TIMELINE OF THE INTERVENTION

The intervention will start by first week of July and the project will last for 8 months. The first phase will be the negotiation with the target groups about SEAM intervention. In my case one university will be selected for horizontal diagnosis. Then two different types of IoT companies, one that makes IoT devices and the other one that has built a 'Big data server', will be targeted and there I will do the Horizontal and Vertical interviews. Later some SEAM tools, i.e. the '*Internal/External Strategic Action Plan'*, the '*Time Management'* and 'Competency Grid') will be introduced to the IoT startup companies. Hidden costs and the creation of potential will be calculated.

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