The University of Sheffield

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INSTRUCTOR'S NAME	**Dr IOANNA STAMATOPOULOU**		

To be completed by the front desk secretary or the course administrator

SIGNATURE	DATE SUBMITTED	HOUR SUBMITTED	MATERIAL SUBMITTED	
	Stamp date		Report Diskette/CD	☐ ☐

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MSc in Technology, Innovation & Entrepreneurship

Coursework in the module of:

KNOWLEDGE TECHNOLOGIES FOR INNOVATION (TIE-4340)

with subject:

Incorporating Knowledge Technologies into existing IT products and services

By
ERGEN Evangelos

Module Director: Dr Ioanna STAMATOPOULOU

Thessaloniki – 14th of November, 2008

ABSTRACT

In this coursework it is aimed to identify (4) different existing IT products/services and evaluate the possibility of extending their usage by incorporating knowledge technologies. The target is to investigate whether this decision will contribute in turning them to become innovative and competitive in the business market.

There is an attempt to clearly understand the nature of knowledge technologies as well as their potential use and alignment with business issues. Moreover, this report will constitute the pathway which could direct to a deeper evaluation and analysis of the proposed services, although this is not fully covered at present. Instead, special emphasis has been given to the identification and evaluation of current services plus the proposal of the new services and how knowledge technologies could be incorporated into them. Furthermore some thoughts and findings are given about potential business and social impacts.

By taking the responsibility of accomplishing this coursework, there is a great challenge which motivates to a research for introducing a number of innovative ideas based in the incorporation of knowledge technologies. It is true that when studying for real cases, where new and customized solutions are suggested, there is no a “wrong-right” relationship. However, there are a number of similar cases already applied, there is relevant experience and there is useful literature that can be adopted and incorporated in the new customized philosophy.

SUMMARY

Purpose – The purpose of the coursework is to introduce, describe and evaluate (4) different existing Information Technology services and how these could be infused by Knowledge Technologies. Moreover, further to the evaluation of the ideas, one of them has been chosen and presented in more details, as the most promising one.

Design/Methodology/Approach – This coursework is a technical report, based in scientific resources, and innovative practices.

Findings – Knowledge Technologies may add value and create growth since they will be adopted properly and widely. Their impact to people and organizations is essential and hide multiple potentials.

Research limitations/implications – Current coursework is based in a number of academic resources related to the investigated areas such as: economy-finance-law-academic services-commerce-IT-transportation. The aim of the coursework was mostly to stimulate the researchers and potential business angels in order to qualify the proposed innovative ideas.

Practical Implications – Special concentration has been given to the analysis and evaluation of each new service. In addition, efforts have been made to describe the incorporation of knowledge technologies in each one of them.

Originality/Value – This coursework was prepared as the seventh paper to submit for the MSc in Technology, Innovation and Entrepreneurship course (University of Sheffield – CITY Liberal Studies). The relevant module for which it is submitted is the ***"Knowledge Technologies for Innovation"***, with module director ***Dr Ioanna Stamatopoulou***.

Keywords – Intelligence, Knowledge Technologies, Information Technology, Innovation

Paper type – Individual Coursework (100%)

TABLE OF ACRONYMS

IT	Information Technology
KT	Knowledge Technology/ies
HLT	Human Language Technologies
NLU	Natural Language Understanding
NLP	Natural Language Processing
NFC	Near Field Communications
ROI	Return on Investment

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INTRODUCTION

Information technology (IT) products do not have a natural obsolescence. *[1]* Since the technological diffusion is bounded to the business market, innovation should be the additional force that fuels IT market growth. Moreover, the increase in serviceability incorporating a social perspective, should constitute an axiom that finally will translate these products to real benefit for people.

Knowledge technologies have a hidden value in their philosophy and this is **intelligence**. The real innovation in software can only be achieved through this. *[2]* Their effort is to extract knowledge from current texts and progress them in real applications. Also known as advanced human language technologies (HLT), their innovative approach involve the creation of a next generation protocol, which will be dealt mostly with meanings and concepts rather than words.

The adoption of new technologies and their incremental or even radical emergence into real business world is necessary to comply with a number of cascading criteria. Innovation cannot be a development-engine by itself, unless this is done within a framework. It is crucial to survey whether a given market will adopt or not an IT innovation. The cascading criteria are the following: *[3]*

- The innovation should provide a technological advantage over existing solutions (may be existed technologies).
- It has to be translated into a clear economical advantage.
- It should demonstrate compatibility with vested needs.
- It should encourage rapid development of complementary technologies.

An IT-enabled business innovation could be the transforming of, a business process or a market offering or a business model, in such a way to boost the value and impact for the enterprise, the customers, or the partners. *[4]*

In this coursework, it is introduced a number of different IT existing products/services and investigated whether these can be infused with knowledge technologies. Through an innovative prism two main axes are maintained as the basis of this effort and these are:

- To scholastically investigate whether each product could be infused with intelligence
- To investigate whether each product show applied business value

Moreover, each technology should be robust and capable of being used in order to prove its scalability and sustainability.

CHAPTER 1.
IDENTIFICATION & EVALUATION
Of 4 DIFFERENT IT PRODUCTS-SERVICES

1.1 Service A

Knowledge recycling for lawyers, using natural language understanding, knowledge representation, machine learning and data mining.

Identifying the problem

There is a specialized IT service, which is addressed to lawyers and law experts (***Lawnet.gr:*** subscription-based), where subscribers get access to a number of on-line services. Among them, probably the most popular, is a database which contains court decisions (case laws). It is necessary for lawyers to have access in such resources, especially when they work on a serious case. Case laws usually contain in their meanings and definitions very significant law skepticisms, which offer compressed knowledge and experience. Therefore, by data entry a set of keywords in the embedded search engine, subscribers get back, as results, the relevant court decisions. Other additional services offered in this subscription-based service are the following:

- An On line directory of Greek laws from 1900 up to date
- The 40 basic Code Practices
- The Greek Constitution
- Official Decisions of the Ministries of Labor, Economy and Public Constructions
- The Collective Agreements as have been signed and validated

Lawyers have the opportunity to search in detail in the above databases. At the end of their research, they usually come up with a pile of documents, which most of the times needs to be categorized, prioritized and reviewed. In continuous, they have to dig in these texts and extract what they really need. Moreover, there is no option for making digital comparisons among similar cases, or make queries to this service based on predefined phrases. Although this is a big sorted collection of specialized information, it cannot be accessed otherwise than through limited options.

The proposal

It is suggested that the specific service should be more effective. Especially concerning the search option, it should revert with more useful and comprehensive results in less time. Moreover it should demonstrate more flexibility, as well as deal well with complexity. Knowledge technologies

could infuse this system and make it more interactive and convenient for the user. The proposed model-service will enable the lawyer, or the researcher, to create personal dynamic profiles of what he is looking for, with the valuable help of keyword expressions. The lawyer could data entry some characteristics, related to what he is looking for, and the service will revert with results such as:

- ready-made summaries of similar cases,
- information on how have been handled similar cases according to case laws,
- comparisons between cases regarding their final outcome,
- relevant law sections and possible useful legal aspects,
- additional information about the opponents in the case,

Assuming that law cases are increasing day after day, it is suggested that the new service would learn and manipulate new information. Main sources of information will remain the ones described above. Moreover, the database would be continuously updated. The proposed model is illustrated in *Appendix A.*

How the technologies are to be employed

By adopting **natural language understanding** technology (NLU), the huge textual material could be interpreted. **Natural language processing** (NLP) is a method for analyzing text that utilizes all levels of human language understanding, in order to accurately represent the contents of the text. *[5]* The grand challenge of NLU is to simulate the human capability. *[6]*
It concentrates its efforts, (a) in creating a store of prior knowledge, (b) in creating representations of the meanings and (c) in integrating these representations into the knowledge store. This characteristic of NLU, could help converting the bulk of law texts into useful and process able information.

Therefore, it could be possible to create keyword phrases, expressions, concepts and relationships that would be derived from all the subscription-based resources. A relevant high promising technique that has been developed is text mining. **Text mining** is growing rapidly as a technology for analyzing large volumes of unstructured textual documents. *[7]* With the help of text mining it is possible to view large amounts of information from a high-level perspective (clustering), it is possible to investigate very specific questions (question answering) and finally it is possible to make hypothesis generation (concept linkages). *[8]*

Text mining was envisioned and developed from computational linguistics, also known as natural language processing. *[9]* It is a high-promising technique that tries to interpret text to make the

information usable. Text mining, in cooperation with a **knowledge representation technique**, would help the machine understands the relationships and develops a semantic approach. The suggestion is to apply an **ontology** as this could direct to a more complete and accurate model.

In the end, data could be stored in a structured database which will be the main resource for data mining. Through the use of **data mining** the lawyer will have the opportunity to create a profile for each case, as he would query the service and retrieve the structured information according to his criteria.

Finally it is crucial to create a knowledge acquisition process for the service, through a **machine learning** technique. For the sustainability of this service, it is necessary new knowledge to be added on daily basis so the process of acquiring for the system should be intrinsic. Actually this will be a cycle of knowledge update.

Evaluating the potential of the new service

Technological issues

The proposed technologies have been already employed for similar services. Current bibliography has given a number of examples. Especially the applications of data mining are widely spread within the business sector. On the other hand NLU is a knowledge technology which continuously inspires researchers, therefore, tools and techniques are developed.

There are no technological restraints or limitations but we foresee possible difficulties during the application of these different knowledge technologies. Mainly this is due to the effort of combining different tools. In result, the period of development have to be under monitoring during the project management plan. It is positive that we will use the same sources as in the primary service, so data availability is reserved. As mentioned, it is necessary for a project management plan to be prepared, where specific details will be processed and guidelines will be given prior to the start.

Business issues

By infusing the existed service with the suggested knowledge technologies, it is expected to increase the subscribers' base since the new tools would convert it to a powerful assistant for a lawyer. That means potential growth for the company who owns the service, and business process re-arrangements as the interactivity with the system will be increased.

This innovative IT product will create a unique new market because it will radically change the parameters used so far from the competition. As a result, competition will follow and the idea is

expected to face strong competitiveness. It is necessary for the company to make an investment plan in order to proceed with the application of new service at the earliest possible time. Special emphasis should be given in the Project Management team, whose members will overview the process of designing, implementing and introducing the new KT service in the market.

Initial costs will refer to project management issues. The Project Management Plan will extract useful information regarding return on investment and timing of service's release. In any case, timing of release should be the earliest possible, possibly in less than a year.

Social issues

The new service will definitely have a direct social impact and affect the daily life of law experts. The expected benefits will focus in: effectiveness, better administration of law cases, improvement of lawyers' credibility and professional status, contribution in country's law system.

As this is a very specialized idea, it will not be of direct public interest, at least as a major factor of affecting people's normal lives. On the contrary, people will be affected through the improvements that will incrementally be done at this area (Justice System). By providing better tools to law officers, they will, in return, improve their service to the Justice System. It is expected to face some resistance though, mostly from the inside professionals. As it is understood, the new system will provide knowledge and experience to everyone at a glance. Therefore, the competitive advantage among lawyers, juniors and seniors, is deactivated. Professional conditions will change and new parameters will be established.

Data protection remains always a significant issue, but at this case, since the new service will keep its subscription-based characteristics, data will be protected by the owned company. Actually, this service handles public data, available in single requests. Therefore, the issue of privacy is not of major concern. In any case, lawyers will create their profiles in their personal computers, so any possible leak will directly concern them and will be a derivative of their responsibility.

1.2 Service B

TURNITIN- An on line plagiarism prevention and detection IT service, following service-oriented architecture using knowledge representation, machine learning, intelligent agent & neural networks.

Identifying an aspect that may be improved

Turnitin (www.turnitin.com) is an on-line academic service, addressed to lecturers and students, which is helpful for the prevention and detection of plagiarism. This is a dedicated option since students submit their assignments on-line in this web site, and in result, the lecturer on the other side, could get the percentage of plagiarism, comparing to a vast a number of resources. This service currently returns a simple percentage. In addition, lecturer has the opportunity to get a full report of student's assignment compared with both the texts and the resources, wherever these have been found in the literature.

The proposal

Based on the fact that each student has a number of obligations and rights, it is assumed that this framework define his academic profile during his studies. Since the production of course works is one of the major academic tasks for the student, it could be interested to get an evaluation on his quality with the help of a survey made in his work and how this has been conducted.

Therefore, the proposal is to extend the current service in **creating an academic credibility profile** for each student. More or less, it would work like the financial credibility that banks keep for their customers. Based in a number of criteria, the new service would identify the degree of plagiarism for each assignment, and would try to categorize the student in a quality level. Since a student has submitted a number of assignments, the service will combine the individual evaluations and finally will give him an academic credibility status (stratification). This status would be an extra assessment criterion for the lecturers. For those lecturers who will not know the student, this information could be used as a preliminary report. Thinking "outside the box", it could be possible that this academic credibility profile to be kept and used as a reference in the future employers.

How the technologies are to be employed

Adopting the philosophy of "credit card authorization" and "purchase order processing", by applying **service oriented architecture** it could be possible to create an additional product which would investigate and keep track of the following:

- Keep record of each coursework submitted by the student with the final plagiarism ratings detected.
- Keep record of the resources used and their variety and origin.
- The system will learn through time and experience and will categorize the student according to definite standards (these may altered from time to time).
- The aim is for the lecturers to get the "academic credibility profile" of the student.
- Academic credibility could be considered as an asset and may alert the lecturer for the working methods of the specific student.

The **service-oriented architecture** is the platform where the new service will be built. Although it is not considered as a knowledge technology, it is significant as it defines the framework where knowledge technologies could be used. Under this philosophy, it is expected to introduce the new service inspired by the real needs and not by the IT potentials.

Since "Turnitin" is an academic tool, knowledge technologies would help it to extend with a number of different aspects which should be added in order to create a wider approach regarding students' academic status.

Raw data at this point are considered, (a) the submitted assignments and (b) the final percentages of plagiarism, as these were detected by the system. Moreover, lecturer could leave in "Turnitin" his final mark plus a short comment report for each coursework. The suggested model could use **knowledge representation techniques** (possibly ontology) in order to "understand" the above key information. A number of given criteria will be applied so the ontology to represent all possible meanings and concepts that are derived from the potential relationships.

Machine learning will be used to make the system learn from raw information and do the categorization. The system will categorize students to an academic credibility scale such as: (a) Excellent, (b) Very Good, (c) Good, (d) Moderate, (e) On limit, (f) Below limit, and this will be done according to definite criteria.

When a lecturer requests for a student's profile, by simply submitting his personal data, he will get back a full report of the specific student's academic background plus an academic credibility report. The final settle to an academic credibility status will be given by an **agent**. This agent should be a piece of software which will match the categorization, the background and the evaluation.

Evaluating the potential of the new service

Technological issues

The skeleton of the service is already on-line and available for the users. The new service will require the implementation of the pieces of software that will establish the knowledge technologies in order to make the categorization and the academic credibility report. Since the number and the nature of knowledge technologies involved in the model, are not complicated, it is estimated that their merging is feasible within a short time period.

Current offered service has already a huge database of relevant information available; therefore first results could be immediately extracted.

Business issues

The final target is the one of integrating people, information and processes by utilizing focused software, services and expertise. The proposed service will differentiate us from the market and give potential for further innovation. Service-oriented architecture will help us to ensure that current IT systems will adapt quickly and economically to the new business needs. *[10]*

The proposed framework of SOA will enable this service to a more business-oriented one with a focus in business and IT agility. *[11]*

Competitiveness in this area is currently limited, since this service is addressed only to the academic sector. Actually each academic institution that participates pays an annual fee to the company as subscription. The new service is expected to expand the significance and the operability of the whole concept, as the extracted data could be used as reference points for both academic and professional issues. Although it may not have a direct business perspective, it is possible, as a tool, to find popularity among academic communities and companies.

It seems that there is no need for any further investment in technical infrastructure. A Project Management plan is necessary to be done in order to define the tasks and the performance targets that need to be followed. Expected completion date of the project is estimated in a one-year period.

The timing of release should be the soonest possible since this will be a unique service and the surprise tactic will postpone any potential competition.

Social issues

In this service, it is recognized a strong privacy issue. Since the academic credibility report, would exteriorize a number of hidden personal information, this is a matter of data protection and privacy. The answer to this issue could be that the student will be aware of his academic credibility status throughout his studies. This will happen under the supervision of his advisor. Among other issues, during his studies, the credibility will be the one of the objective targets for the student to improve and alter, if the time is adequate.
Regarding the possible professional requests, it should be a matter of the student, if he would like or not to use his credibility status as an asset in his resume or not.

Access to these data will have only the lecturers and the advisors of the student and would be processed for their internal use. In case they want to use it or other purposes this could be happen only with the allowance of the student.

1.3 Service C

Exploiting the public transportation bus positioning system, to develop an e-commerce agent; through intelligent agent, knowledge representation, machine learning and the support of near field communication.

Identifying an aspect that may be improved

Recently in Thessaloniki, an information system was established in the local bus transportation network. In the bus stops there are small screens where it is possible for the customers to see the estimated arrival time of a bus line in the specific bus stop.

This is a simple IT service which is based in the current design of bus routes (of the local transportation company) and the duration of time that a bus needs to cover the distance of the route combining to its current position (positioning coordinates). As it is realized, there is a skeleton of hot spots (bus stops) that operate as information centers receiving and sending information, giving customers a solely answer in the question “What time will arrive the bus?”.

This is significant service for passengers, since they did not have such feedback but is showing only a small piece of information of a broader system which operates daily.

The proposal

This simple information system could be infused with knowledge technologies in order to improve its serviceability to customers. Motivated by the fact that traffic is a general problem in the big cities, and can be translated in many waiting-hours for people, it could be an idea to make this situation much more interactive and productive using an intelligent agent for e-commerce and additional e-service purposes.

The proposed service, at this situation could include, **(a)** the ability of getting additional information regarding the buses' route status (where is the bus / is it on the road / is it stacked in the traffic etc), **(b)** the ability of getting more complicated data in order to have a clear picture of where each passenger is located (starting point) and what is the estimated delivery time in his destination according to current situation (dynamic information). Moreover, **(c)** during travel (including waiting time in bus stops), passengers will have the opportunity to interact with a number of e-services through their mobiles (such as make on-line purchases, reply to e-commerce offers from different sellers, make reservations in a theater etc.). All these sub-services will be available in passengers' mobiles. The services will be selective according to their profiles. In *Appendix B*, there is an attempt of illustrating the proposed service

More specifically:

- First it would be necessary for people to register in this new service by providing a short personal profile through their mobile phones. The registration should be sent either to the local transportation company (ΟΑΣΘ) or the IT company that will manage the information system.
- This profile will be analyzed, translated and matched with certain customer profiles.
- The system will learn (agent) from the profile of the customer and will make analysis of his/her habits and preferences, in order to update this profile.
- The new service should track information about current traffic, average number of people waiting in each bus stop, traffic lights, and could give estimated arrival time at the destination of the customer based in the usual route he/she follows.
- It is necessary for customers to use NFC (Near field communication) tags in their mobiles in order to give and get information.
- When entering the bus, the customer could pay the ticket through his mobile.
- During the route (which may be long) he/she will have the opportunity to receive a number of useful information according to his/her profile. There will be the agent which will handle each customer separately and send small posters to his/her mobile with e-commerce

offers. For example if he is a student, he may receive today's offers in books from a bookshop that is around and participates in this e-commerce game.

- The agent will learn customers' habits and adopt e-commerce offers to their needs through the transportation network (artificial shopping agents).

How the technologies are to be employed

First of all people need to be registered. They must have NFC enabled mobile phones in order to get access to the network. Since they acquire such a phone device, when they are in a bus stop they simply "touch" their device to a specific NFC tag which is built-in the construction. **NFC technology** supports short distance communication; therefore while passenger is waiting in the bus stop, he can fill in and send his profile to the company. For creating the network we should adopt WiMAX technology. Each bus stop should be a hot spot and an NFC tag point. Each bus should be a hot spot and have NFC tags inside as well.

NFC will help the system to identify that the passengers are in and out of the network. Also it will support some extra services such as the ticket-payment to the bus. Main purpose though should be the transmission of information between the company's data station and the passenger.

Since passengers will submit a registration profile in the company, for the building of customers' profile it is necessary to adopt a **knowledge representation technique** (may be ontology). It is necessary to give the system the way to understand "what is habit or preference". With the help of this technique the system will understand differences and relations. Through **machine learning**, passengers could be categorized in various categories according to their age, profession, and preferences.

With the use of the same techniques, the information which will come from shops, public companies, such as offers, on-line services etc, will be interpreted and categorized. The information could be sent with the same way just as passengers do. It is necessary of course for the shops to make a registration as well.

The learning process will be done by an **agent**. This should be an **e-commerce agent**. More specifically we are addressing an online recommendation agent, which will facilitate users' decision making by providing advice on what to buy based on user specified needs and preferences. *[12]* This agent will handle the profiles and will do the match making regarding the e-shopping or other e-service opportunities offered by the cooperating companies or the public sector.

Evaluating the potential of the new service

Technological issues

It is true that the suggested service is a little complicated and demands the cooperation of a number of different technologies. Technologies recommended are already in use, but possible limitations regarding their interoperability might be investigated. A technical feasibility study is suggested to be made in order to clarify the viability of the new service. Possible alterations may arise but these are expected to take place within the basic framework which is defined by the proposed knowledge technologies.

Business issues

If the proposed service would be applied in its complete standing, it is expected to create significant benefits especially for the buyers and the sellers. The company may keep a small commission from the sellers that make the offers and expand the services in an auction-based mentality.

Furthermore, such e-commerce agents have the potential to change current market relationships because they work on behalf of the individual. *[13]* It is expected two major factors to be altered through this service and these are (a) the consumer's welfare and (b) competition. The new model will alter competition's rules as the artificial agent may affect consumers' habits throughout time. The aim is not to make an agent that will mimic individual's way of action. In a different sense, the agent will play the role of an information-oriented intermediary in the e-commerce market. On this occasion, the individual will find trust and assurance in the agent.

Social issues

The suggested service creates a new area of service to people. The impact in daily life could be direct, and precious time can be saved from each individual. Since waiting time is unavoidable, this service will enable alternatives. Such alternatives will be: the option to buy tickets on-line for a recital, to make an order to the closest bookshop through a mobile device, to learn a-priori information which otherwise had to look for.

There is though a security issue, especially for the mobile contacts, since it is possible for data to be wirelessly retrieved from third parties. All connections through NFC and WiMAX technologies should be tested on safety prerequisites.

1.4 Service D

Administering an on-line financial portfolio using an intelligent agent (create an investment agent); other technologies involved: knowledge representation, natural language understanding, machine learning and neural networks; also using service oriented architecture as the main platform.

An introductory approach

An old Wall Street adage states that two factors move the market: **fear and greed**. *[14]* So far, the field of finance and the investment world has evolved based on two major assumptions. The first, that people make rational decisions and the second, that people are unbiased in their predictions about the future. "Unbiased" is the hidden value in this new proposed service. Psychology and finance has proved that investors can be irrational. *[15]* Therefore, their predictable decision errors can affect the function of the markets (for example: see current financial recession). Fear, greed and overconfidence affect the mentality of investing and blur the requested clarity, which are necessary for the well-operation of the markets.

Software agents were first used several years ago to filter information, match people with similar interests and automate repetitive behavior. *[16]* Moreover, one of the first innovative practices had included the possibility of making agents that could simply buy and sell. Later, these agents became the mediators of the e-commerce era where, shoppers and sellers alike dispatch them into a digital bazaar, to autonomously represent their best interests. *[17]*

Although, ordinary people and professionals may know and use the tools of modern investing, they both keep on falling in the same traps. They let two major factors affect their decisions and behavior: (a) reasoning errors and (b) psychological biases. In result, wrongly-made decisions in investment market, lead to the decrease of their wealth and prosperity.

Since the area of finance is a most promising one and the suggested service is expected to create real benefit and give value to the company that will first apply it, we will try to be as analytical as possible. Based on a preliminary report (*Appendix D*) that has been made as part of this coursework, we have concluded that this service should be the appropriate one to further investigate. Although it wasn't requested, we have considered it as crucial to make a first research on the potential new services in order to select the most promising.

Identifying an aspect that may be improved

Current technology which embraces financial markets restricts the potential usage of IT services to a definite number of operations having to do mostly with the marketed side. *[18]*

Undoubtedly, such artifacts are useful and profitable but still they do not offer much, and remain the simple tools of a trading day that help investors manipulating their willingness to invest. In addition, non-experts have the opportunity to get in the trading philosophy with the use of such IT services but in a surface level.

For example, there are a vast number of financial corporations, magazines; or web portals, that offer for a small fee or even for free the opportunity to their customers of administering their personal on-line stock portfolio. *[19]*

They support them with advises by feeding with the initial know-how and this operates as a stimulus. Usually such services can administer a small number of stocks, have simple parameters (buy-sell-price) and provide some historical information on each stock. They cannot handle in parallel different investing opportunities (such as stocks, commodities, bonds etc) and they cannot support complex scenarios, that possibly a current trader would like to attend. *[20]*

These are simple IT services, usually provided through a Web page that gives to the customers only the ability to trade. As a result, the investor get information on his monitor about the buy/sell quantities and current prices on his selected stocks (portfolio) and then he, on his own, may decide to trade or not (buy or sell or both).

Basically, such services are providing nothing more than the stock market's intraday in investors' personal monitor. Comparing to the older days, where people were obliged to visit their financial advisors and the access to this information was restricted for mass investors, this is a technological achievement. But, markets change, such as investors' desires and targets.

The proposal

The proposal is to make an investor agent. At this situation, it is not attempted to replace individual's dominance with a software agent. On the contrary, the expectation is to create a real intelligent assistant, through the adoption of knowledge technologies. Experience so far has proven that the bulk of information driven around cannot be exploited since there is not "something" that could identify and evaluate it. The "assistant" is planned to do a lot of this job, currently done by the individuals, and in result will offer a ready-made platform of financial services to the investor. Such result will give the capability to the individual of working in a higher more sophisticated level. The individual-investor will predefine the criteria upon which the "assistant" will operate and do its research and suggestions. Therefore, the new service will gather information from a number

of resources, evaluate them and make suggestions to the investor or reply to queries. Also it could execute trading decisions if allowed by the investor.

This innovative approach, is aiming to add value in the IT services which are currently offered to the financial market. In fact, current services have limitations and weaknesses. These weaknesses have constituted the basis of the inspiration, to start searching for a change. We will try to transform these weaknesses to advantages through the new service. Innovative thinking may be stimulated from the source of a problem and its consequences. Therefore, below is given a small description of the weaknesses identified, implying what we would really desire to achieve as investors by introducing the new service:

- Limited investing-scenario alternatives, as the investor cannot handle investing products of different nature in his portfolio simultaneously. *[complexity]*
- No teaching ability. The system does not have interactivity with the investor. As a result, there are no available learning channels. The knowledge cannot be recycled or retrieved at later and appropriate times. *[learning]*
- The service does not provide an embedded operation of supplying the investor with useful news, relevant to his nature of investments. Instead, the individual is obliged to dig in a number of information resources (web pages, newspapers, magazines, other literature etc) in order to create an information base. Sometimes, this information is data based in a piece of software but most of the times it remains in the back-head of the investor. So much knowledge stands alone with the risk of being lost. *[knowledge]*
- Although there is the option of getting a history profile, where the investor can recall diagrams and past progresses, these are provided as simple unprocessed data. Simple memory illustration. No records of causes or events that affected the investment on that period are provided. Questions such as "why" or "what if" are difficult to find replies. *[history & experience]*

The above limitations will create the platform upon which the new service will be constructed. By taking these limitations and converting them into powerful tools, it is expected to cover the needs and demands of the investors. Financial markets and financial intermediaries are parts of a system which includes entities such as: (i) savers, (ii) borrowers, (iii) direct and, (iv) indirect finance. *[21]* Moreover, an enormous set of rules and regulations define a framework which circles around market risk. Risk exposure, high risk-high return attitude, and the risk-based scenarios, remain in the center of investing attitude.

The proposal is to make a complete service which:

- will recognize and accept information from different financial resources; such as web pages, articles, books, financial reviews *(feeding process)*
- will monitor and evaluate the information and will make the categorization *(monitoring process)*
- will create a knowledge base with expressions, relations, keywords, history, profiles and will learn from these information *(learning process)*
- will develop potential investment scenarios based on its knowledge base *(learning process)*
- will administer risks derived from the scenarios *(learning process)*
- will handle different investment products simultaneously *(learning process)*
- will make suggestions to the user about investing opportunities *(decision making process)*
- will reply to queries made by the user who would like to get feedback *(decision making process)*
- will execute for the sake of the user a number of financial transactions related to his/her investment portfolio *(executing process)*

How the technologies are to be employed

First of all the proposed service will be designed and implemented under a different philosophy. A **service-oriented architecture** is necessary to be used as the basic platform. Services have to adapt to user needs and not be restricted to what current IT services could offer.

There will be an **intelligent agent** as the central knowledge technology to be infused. The agent will administer all processes but do not act autonomously. An intelligent agent is a piece of software that acts on behalf of the user. *[22]* In this model the agent will perceive, reason and communicate with the user. In *Appendix C*, there is an effort to illustrate the suggested model as a whole. More specifically, the agent will have 4 axes upon it will be based. Trying **to imitate a simple human operation,** where an individual is getting information from the outside, identify it, categorize it, store it to his memory, think , decide and execute, there will be 4 similar-oriented operations and these are:

1. Feeding
2. Sensing (monitoring & learning)
3. Decision making (Planning: risk adjustment model, hybrid planner, query manager)
4. Executing

In "Feeding" the agent will find and import all information available. A **knowledge representation technique** (semantic web – ontology) could be used for the "feeding process", in order for the system to identify and import the appropriate information about financial issues (mostly retrieved from the web).
In the phase of "Sensing", **natural language understanding** techniques could be used in order for the system to interpret and understand the information given from "feeding" and with the help of **machine learning** do the categorization (may be done through supervised learning technique).
The learning operation will be based in the database philosophy, where three main elements will exist: the knowledge base, the history and the profiles. These elements will accommodate the filtered data in a format that could be retrieved by the agent in order to do the "decision making".

Furthermore, machine learning tools will be used to ensure that the model will be sustainable and the new service will continue to recycle the knowledge that will be derived from the process.
That means, feeding with new information on daily basis, reviewing the interaction with the investor made throughout the process and keeping updated the databases.

By using the technology of **intelligent agents**, the new service could be effective and develop a high interaction with the user. The agent will learn from the investor's preferences and manage the 4-pronged model accordingly.

Past decade has witnessed an increased use of **neural networks** in insurance related applications. *[23]* Currently there are a number of approaches on health insurance schemes. Such schemes are extensively investigating the risk factor. Risk factor is a primary parameter for the stock market, as well. The incorporation of **neural networks** may help in creating ***a risk-adjustment model***. There is similar experience so far, which although has covered other areas of expertise, it is assumed that can be transferred to the financial scheme. The risk-adjustment model will be part of the decision making operation and will constitute an extra tool before the final suggestions will be made by the agent. Risk can be mitigated by identifying potentially damaging activities. This also could be happening using neural networks and in particular pattern recognition. *[24]*

It is expected the proposed service to be able to handle three different sources of investment simultaneously with the possibility of adding two more. These will be:

1. Stocks (stock market)
2. FOREX, foreign exchange market (currency market)
3. Commodities (trade of goods, and investment in their prices, such as gold, silver etc)

The two additional sources will be:

1. Administering of a number of mutual funds
2. Real estate products

Evaluating the potential of the new service

Technological issues

The whole model is based in existed technologies. Data that are necessary to be retrieved during the feeding process are available but spread. These make the project feasible but needs to be closely evaluated in order to estimate the required period of development.

Intelligent agents have the opportunity to apply a proactive behavior in order to satisfy their goals and further their objectives. It is true that the proposed service incorporates many knowledge technologies. Their essential combination could need more time and may raise limitations. This appears to hide challenge and reward. Since resources of data and knowledge technologies are currently available, it is expected to apply a detailed Project Management Plan in order to realize the real implementation procedures.

Business issues

The "investment agent" is considered to be a high-end service which could finally add value to the financial market. Its utilization is expected to alter the requirements in the daily trading. Furthermore, as a product, it will give a potential for expanding its abilities later on. For example, through time, new services may be added, that will shape a more qualitative profile of the agent.

One important distinguishing characteristic of agents is their ability to adapt. *[25]*

Collaborative advanced knowledge technologies remain in the centre of research for the scientific community. A number of efforts and experiments are worth mentioned. *[26]*

Besides that, these technologies may be applied in daily life creating values and benefits for both people and companies.

Well-managed knowledge technologies can provide an enterprise with an invaluable asset: true and lasting alignment. *[27]*

Social issues

Through the adoption of knowledge technologies, the proposed service is aiming to achieve a high percentage of interactivity with the investor in order to operate as a real supporter. Since, humans are affected by their psychological biases and act irrationally, the existence of such a service is necessary, especially when significant decisions have to be made. The agent could help directly the investor through their interaction. In the end, human weaknesses could be manipulated with the

support of technology. At this point, technology will help the investor to make decisions with clarity, as less biased as possible. At least the tool will exist and whoever will use it appropriately will gain further benefits and see returns in his investments.

Concerning any potential social impacts, the use of such innovative technology will be ingrained within a complex matrix of social relations. *[28]* These relations embrace various entities, which are the investors, the financial companies and the markets. The most important issue will be that the "investing agent" will affect the investing culture. Moreover, it is expected this technological service to create a different framework of learning for the individual. It will change the perception of the user about what knowledge technologies can do for him; it will change the flow and formation of knowledge and finally will shape the learning habits. Not far, this will form through time a new mentality.

Therefore, impacts are expected to be both in organizational and cultural issues.

CONCLUSIONS

The attempt wasn't to suggest complicated and hard to apply services. Instead, trying to be inspired by the nature and mission of knowledge technologies, it was aimed to introduce (4) innovative ideas that would improve people's lives and add value to the business sector.

Based in a number of resources and practices, each idea was separately described and evaluated in the sense of clearly realize its feasibility and potential benefits. As mentioned in the introduction, special emphasis was given in the identification and evaluation of current services and the areas to be improved. As a result, most of the coursework referred to knowledge technologies and how these could be incorporated. Other issues such as social impacts, business concerns and technological potentials were described but not in depth. We consider that for each idea it would be necessary to develop a Project Management Plan and appoint a Project Manager and a team. This technique could guide all efforts and give answers in essential queries about each product's development.

The last service described, is considered as the promising one due to its significance and immediate impact to people. Economy and finance are two interrelated areas mutually affected. Since the occupation with stocks and other investment products are found in the centre of interest during last years, the introduction of such an intelligent agent could boost current trading and change financial standards.

Concluding we would like to emphasize that knowledge technologies provide a framework where various aspects could be developed in order to define a capability which can be used for knowledge innovation, scientific problem solving and quality assurance for knowledge work. This framework can be seen as a "knowledge technology that can be developed and implemented like any other technology. *[29]*

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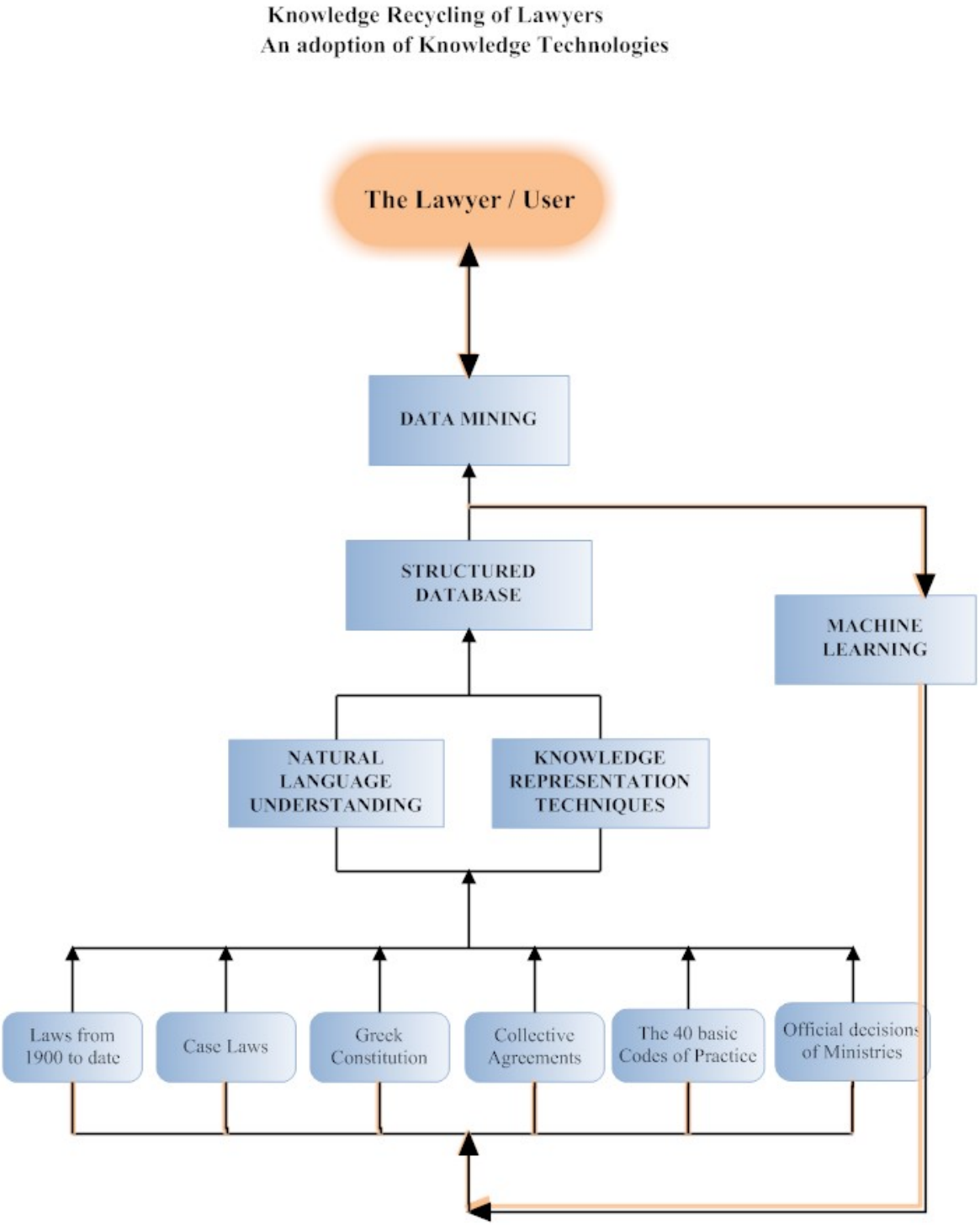
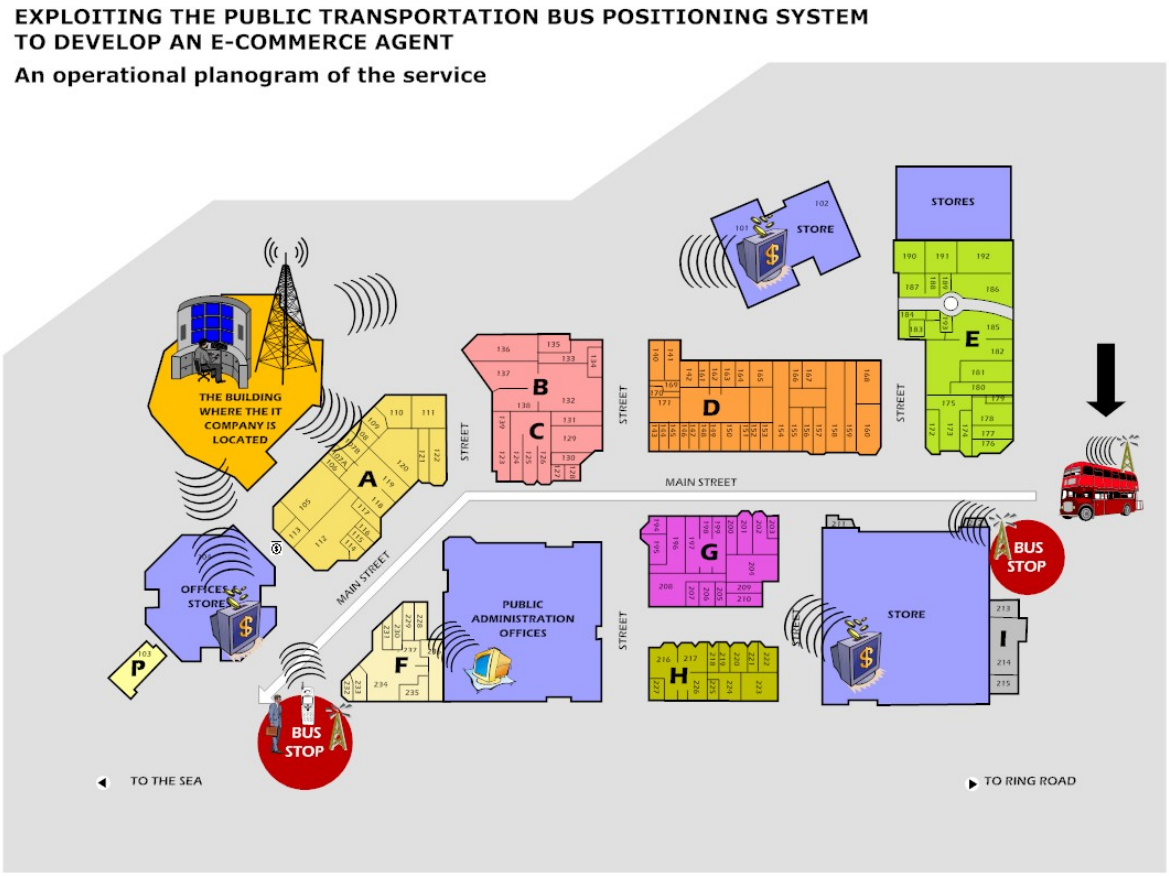
APPENDICES

Appendix A


Knowledge Recycling of Lawyers
An adoption of Knowledge Technologies
The Lawyer / User
DATA MINING
STRUCTURED DATABASE
MACHINE LEARNING
NATURAL LANGUAGE UNDERSTANDING
KNOWLEDGE REPRESENTATION TECHNIQUES
Laws from 1900 to date
Case Laws
Greek Constitution
Collective Agreements
The 40 basic Codes of Practice
Official decisions of Ministries

Appendix B

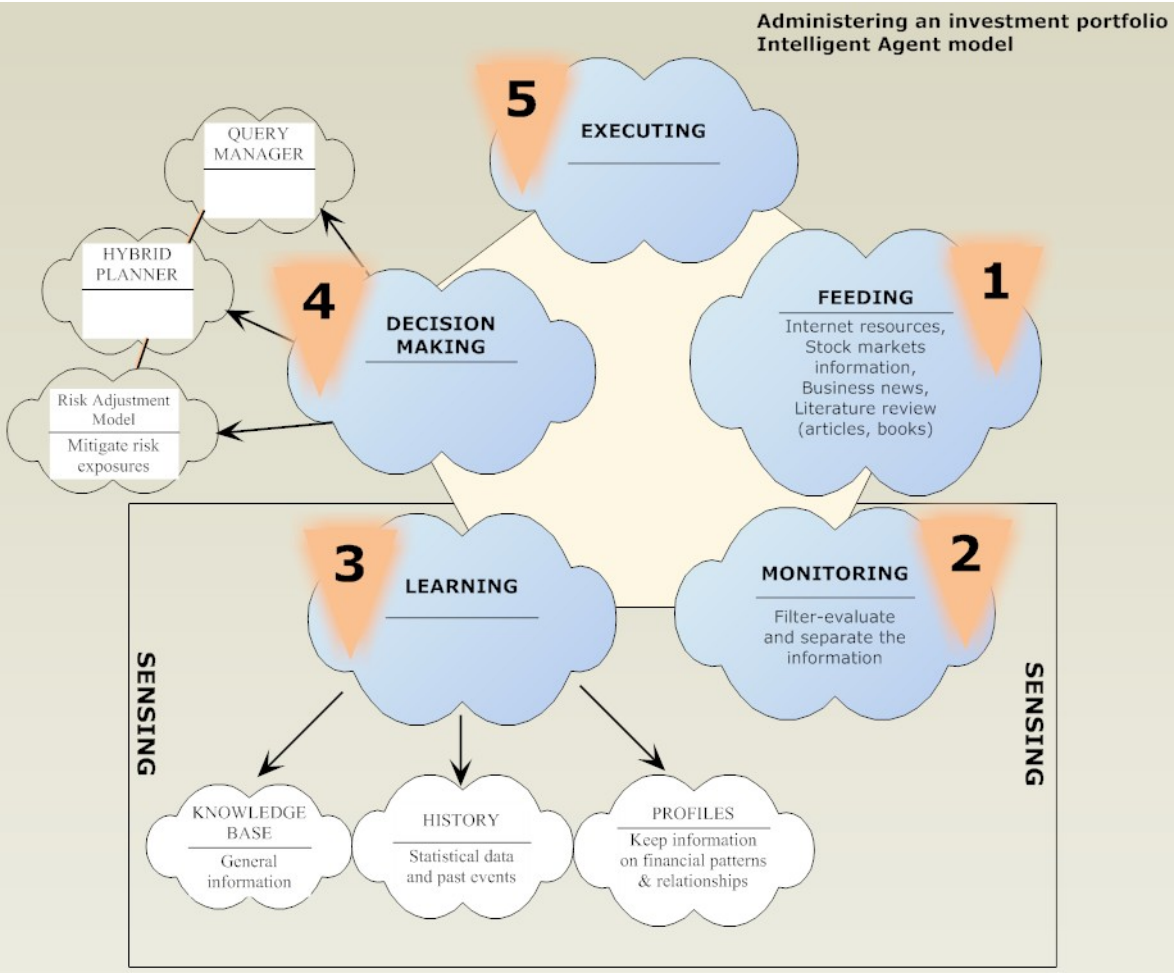


The above map illustrates the communication channels that could be developed in order for the e-commerce model to take place, with the use of WiMAX and NFC technologies.

Participated entities are:

- The company which will offer and administer the new service
- People as users
- Stores as traders
- Public transportation company through buses
- Public administration offices as they will give the opportunity to people through this service to make requests for documents and complete tasks on-line

Appendix C


Administering an investment portfolio
Intelligent Agent model
5
EXECUTING
QUERY MANAGER
HYBRID PLANNER
4
DECISION MAKING
Risk Adjustment Model
Mitigate risk exposures
FEEDING
1
Internet resources, Stock markets information, Business news, Literature review (articles, books)
3
LEARNING
MONITORING
2
Filter-evaluate and separate the information
SENSING
SENSING
KNOWLEDGE BASE
General information
HISTORY
Statistical data and past events
PROFILES
Keep information on financial patterns & relationships

Appendix D

A preliminary report

Suggestion of 4 different IT products/services

1. Knowledge recycling for lawyers (data mining)
2. Turnitin – Online plagiarism prevention & detection system (service-oriented architecture)
3. Using the public transportation internal positioning system / estimating arrival hours (agents for e-commerce)
4. Administering an online financial stock portfolio (agent – intelligent agent & neural networks)

How these services can be benefited by the existing knowledge technologies?

Knowledge recycling for lawyers

Currently there is an IT service offered to lawyers (with subscription), where they get access to a database containing a number of court decisions. It is almost obligatory for lawyers to have the opportunity of gathering as many data as possible when they are dedicated to a case. This service is simple. By data entry in a fairly simple interface some keywords, they get back a number of relevant decisions. At this point they usually have a stack of documents, with possible similar material to what they are searching for.

Most of the times, they are obliged to dig in these data and spend hours to compare their information to what they really need. In general, this is a tool that helps them to get past experience and acquire the know-how from previous cases.

Necessary, useful, but needs time for someone to find the desired information. We propose with the use of **data mining** that the lawyer will have the opportunity to create a profile for each case. He can data entry some main characteristics and the "system" will revert with filtered results, ready-made summaries of other cases, suggestions on how to handle the case and a relevant statistical history. Moreover, he will have the ability to search and find information of his client and the opponents regarding their court history. This service will work both wise. Get a portfolio of similar cases and get a profile of the people involved in the case.

Turnitin – Online plagiarism prevention & detection system

This is a purely academic service so far, very helpful for the prevention and detection of plagiarism. Based on the fact that each student has a number of obligations and rights as a student we realize that this framework defines his academic behavior. Since the participation in course works is the ultimate educational product for the student, it would be interested to get data on its quality.

Adopting the philosophy of "credit card authorization" and "purchase order processing", by applying **service oriented architecture** we may create an additional product which would investigate and keep track of the following:

- Keep record of each coursework submitted by the student with the final plagiarism ratings detected
- Keep record of the resources used and their variety and origin
- The system will learn through time and will categorize the student according to definite standards (these may altered from time to time)
- The aim is for the lecturers to get the "academic credibility profile" of the student
- Academic credibility could be considered as an asset and may alert the lecturer for the working methods of the specific student.

Since "Turnitin" is an academic tool, knowledge technologies would help it to remain as it is, but to an extent where different aspects should be added to create a wider approach regarding students academic status.

Using the public transportation internal positioning system / estimating arrival hours

Recently in Thessaloniki, it was established an information system in the local bus transportation network. In the bus stops there are screens where it is possible for the customers to see the estimated arrival time of a bus line in the specific bus stop.

This simple positioning system can be infused with knowledge technologies and improve its serviceability to the customers.

- First it would be necessary for people to register in a new bus service by providing a short personal profile.
- This could be done through mobile device.
- The new service should track information about current traffic, average number of people waiting in each bus stop, traffic lights, and can give estimated arrival time at the

destination of the customer based in the usual route he follows. The system will learn from the profile of the customer.

- Customers should use NFC (Near field communication) tags in their mobiles in order to give and get information.
- When entering the bus, the customer could pay the ticket through his mobile.
- During the route (which may be long) he will have the opportunity to receive a number of useful information according to his profile.
- There will be an agent which will handle each customer separately and send small posters to his mobile with e-commerce offers. For example if he is a student, he may receive today's offers in books from a bookshop that is around and participates in this e-commerce game.

The agent will learn customers' habits and adopt e-commerce offers to their needs through the transportation network (artificial shopping agents).

Administering an online financial stock portfolio

The aim at this application should be to create an agent that will handle a personal investment portfolio based on specific budget according to criteria. The agent should attend and keep close track of financial events in the stock market.

Some additional abilities should be to:

- Buy and sell stocks
- Suggest alternative ways of investing based on current situation
- Develop different scenarios of a possible investment path
- Evaluate companies' financial indexes and extract summary reports on their potential growth
- Keep track of the CEO's history in their careers through the market and create reports on their achievements and attitudes
- Administer the portfolio and seek for guidelines from the owner such as:
    - ✓ Risk exposure
    - ✓ Desired diversification of the portfolio
    - ✓ Time of return

Possibly this is the most promising that we plan to describe in detail.

In the section of Appendix, we are giving two mind maps. The first tries to illustrate the key points of knowledge technology, as described in the taught Unit. The second is an attempt to gather and map the ideas requested in the coursework.

Some literature found so far (unsorted):

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The Appendix section of the preliminary report