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USE OF QR CODES IN VAMK

Technology and Communication

2012

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Mechanical and Production Engineering

ABSTRACT

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Title	Use of QR Codes in VAMK
Year	2012
Language	English
Pages	55 + 4 Appendices
Name of Supervisor	Saarikoski Lotta

Mobile technology is developing and spreading worldwide at a very high pace. Therefore there is a huge demand for tools like "QR codes" that can help mobile phones and other portable devices users to have an easier and faster access to information.

As an institution that always promotes innovation, Vaasa University of Applied Sciences together with Technobothnia research centre decided to embark on this pilot project in order to use QR codes as information sharing tool in their everyday activities. The aims of this pilot project are: to improve knowledge sharing at TB mechanical engineering laboratory by generating QR codes for some machines and equipment in that laboratory linking to their respective description and data sheet information on the new Technobothnia website. Secondly, the development of Finnish for foreigner's language learning material having QR codes.

This was achieved firstly, through data and information gathering of the machines and equipment in TB mechanical engineering laboratories and uploading them on the new TB server. The QR codes of each machine or equipment was then generated using the URL of the data sheet of the respective machines. Secondly, Finnish for foreigners' language leaning material was developed with the particularity of having a QR code embedded on each pages linking to a video that we produced and uploaded on YouTube.

Keywords Knowledge Management, Information Sharing, QR Codes, Language learning material

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ABBREVIATIONS

AI	Artificial Intelligence.
KM	Knowledge Management.
KC	Knowledge creation
QR CODES	Quick Response Codes.
TB	Technobothnia research centre
VAMK	Vaasa Ammattikorkeakoulu.
URL	Uniform Resource Locator
1D CODE	One dimensional code.
2D CODE	Two dimensional code

Acknowledgements

This thesis marks the end of my journey in obtaining my Bachelor of Sciences in Mechanical Engineering. I was not alone throughout this trip. Therefore I will like to take this opportunity to thanks all those that by one way or the other helped me to achieve my objectives.

First of all, Almighty Allah who gave me strength and inspiration to do this work. Without him in my life I would not have got this far. Secondly, my supervisor Lotta Saarikoski, who always kept me on track throughout my work with her support, guidance and encouragements. Under her guidance, I learned quite a lot.

I am also highly indebted to Dr Agbejule Adebayo for his valuable advices and his motivational speeches. Whenever my moral was down, he always knew what to say to keep me going and to make me believe in myself and what I can do.

I take this opportunity to acknowledge Vaasa University of Applied Sciences especially its mechanical engineering department for providing us advance facilities and high quality lectures for this special programme.

Last but not the least I would like to thank my parents Nzamba Jeanne Pierrette and Bello Sikirou M. for the encouragements and prayers. My brother Ibrahim Kassa Bello and all my siblings for their support and his valuable advices. Also all my colleagues with whom I had a very nice time and helped me to understand a lot of thing in life.

Abdoul-Hafeez Bello Mounguengui

1 INTRODUCTION

Knowledge management (KM) and information sharing are very critical in the everyday operation of any company/institution in today's world. Therefore, scholars and researchers all over the world work every day on developing new technology tools for a safe and better KM and information sharing in any business industry.

1.1 Background to the Thesis

Computers are found everywhere nowadays and we are now surrounded with all kind of objects equipped with computer technology. Mobile phones are widely spread and are equipped with the latest technologies; high internet connection, high processing speed, bigger colour displays (Rouillard, 2008).People are now using mobile phones to have access to all kind of information online. Technologies like QR Codes are now being used more and more due to the fast development of mobile phones worldwide linking the physical world to the Internet with a simple scan.

Like all institutions in the world, Technobothnia which is the educational research centre of three universities in the City of Vaasa is also very concerned with its knowledge management and information sharing system. This is why the management team of Technobothnia together with the Mechanical Engineering department of Vaasa University of Applied Sciences (VAMK) decided to do this pilot project developing a new knowledge management and information sharing tool using mobile phones and QR code technologies in order to ease the flow of information and data among all the institutions working together in this research centre.

Finnish language is a very complex one, and with the number of foreigners coming to Finland increasing every year, people are becoming more and more interested in it. A lot of Finnish for foreigners' language learning materials have been published and can be found online. Despite having all these learning materials in the market, there is still a need for self-learning material that the reader can read and at the same time listen to the written material with the help of a smart phone, not needing to have a computer or an audio device like a CD player to easily get familiar with the language pronunciation.

QR codes are one of the most commonly used 2D bar codes in the world. They have an automatic recognition method combined with high accuracy scanning, low cost, high data capacity storing and damage resistance (Chang,Chu & Chen, 2007). The integration of QR codes on the machines in all the laboratories of the research centre, and on a language learning material will help in improving information sharing between all stakeholders in the research centre, and also improve learning results and increase the interest of foreigners in learning Finnish.

The development of this new tool will only lead to a successful result if the lecturers and students who are going to use it are well informed and educated on how it works and given all the advantages of it.

1.2 Objectives and Limitations

This thesis aims to propagate QR codes technology in VAMK by introducing QR codes in different educational areas at the university. There are two main objectives in this pilot project:

The first objective is to improve knowledge sharing at TB mechanical engineering laboratory. This will be done by creating different QR codes that will link the machines in the laboratory with their data sheet pages on the new Technobothnia website. Generated codes will be pasted on selected machines in the laboratories of the mechanical engineering department.

The second objective of this pilot project is to develop a new type of Finnish for foreigners' language learning material. Experience has shown that learning Finnish is not an easy task. As the number of foreigners attending VAMK is always increasing, developing a material with QR codes linking the text to video files online will not only increase the interest towards the language but also gives the students an opportunity to learn effectively anywhere provided that there is an Internet access and a smart phone or phone equipped with camera available.

Technobothnia is a research centre that consists of many laboratories: IT, electrical engineering, environmental engineering, and mechanical engineering among others. Since this is just a pilot project, only the mechanical engineering laboratories will be considered.

1.3 Structure of the Study

The remainder of this thesis is structured as follow. In chapter two, we have the presentation of Technobothnia. Chapter three is about the role and importance of knowledge management in an institution and how it helps in improving the flow of information and data gathering. Chapter four is about QR codes, the technology and its different applications. We will also see how we can generate our own code online. In chapter five, the project itself will be presented i.e. the analysis and processing of the results of our questionnaire that will be shared to students on campus to find out how familiar they are with 2D bar codes technology. The integration of QR code in Technobothnia and in the Finnish for foreigners' language learning material will presented in this same chapter. Finally the conclusions and recommendations drawn from this project are done in chapter six.

2 COMPANY PRESENTATIONS

2.1 Technobothnia

Located at around 1.5km from the city centre of the City of Vaasa, Technobothnia is a technical research centre with the particularity of bringing together three different universities. Since the city of Vaasa is the industrial capital city of Western Finland, it is not by coincidence that Technobothnia is found in Vaasa.

It all started way back in 1849 when technical education was initialized in Finland in three cities: Vaasa, Helsinki and Turku. Technology real school in Vaasa (Tekniska Realskolani Vasa) was the name of the one established in Vaasa.

The construction of Technobothnia was a huge joint project involving different stakeholders: Ministry of Education, the city of Vaasa, the University of Vaasa, Vaasa University of Applied Sciences and Novia University of Applied Sciences. The research centre is found on the same campus as these three universities who share the centre in perfect symbioses and harmony.

As a lot of companies are found in Vaasa, Technobothnia plays a key role in innovations and the development of new technologies by working together with these companies.

The mission statements of Technobothnia are:

- To provide a framework for high-standard research and education in the field of technology.
- To serve as a channel of cooperation between educational institutions, enterprises and other research institutes and technology centres.
- To offer research, and product development, as well as education, measurement and testing services to the private and the public sector(Technobothnia, 2009)

2.2 The Universities

As we mentioned earlier, Technobothnia is a research centre that brings together the three mains universities in the city of Vaasa: Vaasa University of Applied Sciences, University of Vaasa and Novia University of Applied Sciences.

- **Vaasa University of Applied Sciences (VAMK)**

Vaasa University of Applied Sciences (VAMK) started as a temporary polytechnic on 1st of August 1996 and was the result of the partial merging of five institutions in Vaasa: Vaasa Institute of Technology, Vaasa Commercial College, Vaasa College of Hotel and Restaurant Services, Vaasa College of Health Care and Vaasa College of Household and Social Services.

After a short experimental period, the institutions were given the license to go ahead and form one unique university of applied sciences (VAMK, 2011).

Today VAMK is a tertiary level educational institution with modern facilities, multi-cultural and international learning environment. The school offers both Bachelor and Master programs in Business Administration, Engineering, Information Technology, Environmental Sciences, Hospitality Management and Social Services as well as educates Registered Nurses and Public Health Nurses in Finnish, Swedish and English.

The university has over 3600 students out of which 500 graduates annually, 300 staff members (170 faculty members), 17 undergraduate degrees, 3 postgraduate Professional Master´s Degrees and up to 10 degree programs in adult education per annum(VAMK, 2012).

Since 2010, the school is operating as a Limited Liability Company. Vaasan ammattikorkeakoulu VAMK Ltd. which is owned by is owned by the city of Vaasa, University of Vaasa, Regional Council of Ostrobothnia, Ostrobothnia Chamber of Commerce and Hanken School of Economics (VAMK, 2011).

- **University of Vaasa**

It all started on the 27th January 1966 when the council of state decided to establish a school of economics in the city of Vaasa, and two years later the university was opened to students.

In 1977, along with other higher level educational institutions in Finland, the university became propriety of the state. The university became member of the multidisciplinary universities network of Finland in the 1980s.

In 2004 the institution became independent in organizing technology studies and today, the University of Vaasa is an institution that focuses on business, languages, communications, public administration, and technology (UWASA, 2007).

The University of Vaasa is a multidisciplinary institution with business programs being their main focus. As an international institution, the school offers various programs in Finnish, Swedish and English. The University currently has over 5000 students in different degree programs right from bachelor degree to the doctoral level and around 450 staff members (UWASA, 2011).

- **Novia University of Applied Sciences**

Novia University of Applied Sciences is a multi-disciplinary University in Finland. The school has about 4000 students and a staff workforce of 400 people.

The university was established on the 1st August 2008 following the fusion of Svenska Yrkeshögskolan and Yrkeshögskolan Sydväst. Today the school has five campuses spread all over the country Jakobstad/Nykarleby, Vaasa (Seriegatan and Wolffskavägen), Raseborg and Turku.

In all the university is offering 34 bachelor's degree programs in Swedish and English. The English programs are offered only in Vaasa, Turku and Raseborg.

2.3 The Organizational Structure of Technobothnia

As mentioned above, Technobothnia is the result of the unification of the laboratories of the three main universities in the city of Vaasa. It covers a surface area of about 8000m^2, contains laboratory equipment and is divided into ten laboratories which are shared by the partner universities where each of them manage and invest in their own laboratories (Technobothnia, 2011).

The different laboratories found in Technobothnia are: Mechanical Engineering, Electrical Engineering, Information Technology, Construction Engineering, Environmental Engineering, Energy Technology, Automation Engineering and finally, Vehicle Technology.

Technobothnia being a research centre also provides services and product development services to local companies by putting at the disposition of companies its highly experimented staff and also students.

The current management team is made up of: Erkki Antila, Dean of the Faculty of Technology at the University of Vaasa, Jorma Tuominen, Dean of Technology and Communication at Vaasa University of Applied Sciences, Jonas Waller Dean of Technology and Communication at Novia University of Applied Sciences and finally the Manager of TB Timo Kankaanpää (Technobothnia, 2011).

There are many stakeholder groups operating in TB. Therefore it is very important that TB's related information and knowledge are shared in effective ways among these stakeholders. In this thesis, we develop one solution that will help in information sharing of TB. In the following chapter we will discuss knowledge management and information sharing in an organization.

3 KNOWLEDGE MANAGEMENT

In this chapter we will look at the different definitions of knowledge management, the different types of knowledge management, and finally the importance of knowledge management in an organization.

3.1 What is Knowledge Management

For the last past decades, the concept of knowledge has been addressed by scholars all over the world. The tremendous advances in information technology sector have considerably helped the fast development of knowledge management in different types of organizations. More and more researchers in information technology are always working on developing new tools for a better knowledge management system (Vandaie, 2008, 920-926).

Knowledge management is a very broad topic on its own. Over the years, different scholars came up with different definitions depending on the context and where it is applied.

Jay Liebowitz and Isaac Megbolugbe (2003) said Knowledge management are the steps in which the intangible asset of an organization are developed in order to give them value. In other words, knowledge management is the area that deals with how an organization can better manage its knowledge internally and externally.

Knowledge is described as a "mix of framed experience, values, contextual information and expert insight that provides a structure for evaluating and integrating new experiences and information. Most of the time in organization, it becomes part of the organization everyday routines, processes and standards" (Alhawaria, Louay, Karadshehb & Taletc, 2012, 50-65).

Holsapple and Joshi (2004, 593-612) defined knowledge management as an automatic and deliberate effort made by an organization in order to expand, culti-

vate, and apply available knowledge in any ways that can add values to the organization.

“Knowledge can be viewed as the result of merging information with practice, perspective and expression, resulting in insinuation and presents approaches and plans on which decision is based on”(Alhawaria, Louay, Karadshehb & Taletc, 2012, 50-65).

KM can also be defined as the art of making information and intellectual assets becoming a permanent value for the institution or the organization, its partners, and its customers. Moreover KM is the strategic means of managing this valuable resource, by encouraging a unique approach “to identifying, capturing, structuring, organizing, retrieving, sharing, and evaluating an enterprise’s knowledge assets” (Alhawaria, Louay, Karadshehb & Taletc, 2012, 50-65).

According to Nevo and Chan (2007, 583–597), Knowledge management takes care of policies, strategies, and techniques aimed at helping an organization’s competitiveness by maximizing the conditions needed for efficiency improvement, innovation, and cooperation among employees.

From the above definitions of knowledge management, we can see that there is an evolution in the concept itself and how it is seen by scholars over the years. Table 1 below shows a summary of the different definitions of KM developed during the time period 1994 – 2006.

Table 1. Knowledge management definitions from 1994-2006 (Nevo & Chan, 2007, 583–597).

YEAR	DEFINITION
2006	‘‘Knowledge management addresses policies, strategies, and techniques aimed at supporting an organization’s competitiveness by optimizing the conditions needed for efficiency improvement, innovation, and collaboration among employees.’’
2005	‘‘KM is defined as doing what is needed to get the most out of knowledge resources.’’
2003	‘‘Knowledge management is defined as the organized and systematic process of generating and disseminating information, and selecting, distilling, and deploying explicit and tacit knowledge to create unique value that can be used to achieve a competitive advantage in the marketplace by an organization.’’
2003	‘‘Knowledge management may be defined as doing what is needed to get the most out of knowledge resources. Knowledge management focuses on organizing and making available important knowledge, wherever and whenever it is needed.’’
2003	‘‘Knowledge management concerns an organization’s ability to develop and utilize a base of intellectual assets in ways that impact the achievement of strategic goals.’

2003	‘‘We can conceptualize knowledge management as a process whose input is the individual knowledge of a person, which is created, transferred and integrated in work teams within the company, while its output is organizational knowledge, a source of competitive advantage.’’
2001	‘‘Knowledge management refers to identifying and leveraging the collective knowledge in an organization to help the organization compete. . . . ‘‘Knowledge management is largely regarded as a process involving various activities . . . At a minimum, one considers the four basic processes of creating, storing/retrieving, transferring, and applying knowledge.”
1999	‘‘Knowledge management is the formal management of knowledge for facilitating creation, access, and reuse of knowledge, typically using advanced technology.’’
1999	‘‘Knowledge Management is a business process. It is the process through which firms create and use their institutional or collective knowledge. It includes three sub-processes: *Organizational learning*—the process through which the firm acquires information and/or knowledge *Knowledge production*—the process that transforms and integrates raw information into knowledge which in turn is useful to solve business problems *Knowledge distribution*—the process that allows members of the organization to access and use the collective knowledge of the firm.’’

1999	‘‘Managing knowledge is a multidimensional process. It requires the effective concurrent management of four domains: content, culture, process, and infrastructure.’’
1998	‘‘A term which has now come to be used to describe everything from organizational learning efforts to data base management tools.’’
1996	‘‘The management of knowledge goes far beyond the storage and manipulation of data, or even of information. It is the attempt to recognize what is essentially a human asset buried in the minds of individuals, and leverage itinto an organizational asset that can be accessed and used by a broader set of individuals on whose decisions the firm depends.’’
1994	‘‘In its broadest sense, knowledge management (KM) is a conceptual framework that encompasses all activities and perspectives required to making the organization intelligent-acting on a sustained basis. KM includes activities to gaining overview of, dealing with, and benefiting from the areas that require management attention by identifying salient alternatives, suggesting methods for dealing with them, and conducting activities to achieve desired results.’’

3.2 Types of Knowledge

Almost all scholars agree that there are two types of knowledge i.e. *tacit knowledge and explicit knowledge*. Some add implicit knowledge to that list but it does not have too much recognition within the knowledge management literature (Freeze & Uday, 2007, 94 - 109).

In this section we will look into tacit and explicit knowledge and see where they are related.

3.2.1 Tacit Knowledge

Tacit knowledge has been the focus of many research works and it has got many different definitions: Tacit knowledge is the unorthodox form of knowledge and it is less familiar. It is the type of knowledge that we have but are unaware of its existence in us. Tacit knowledge cannot be codified, neither can it be transferred by means of a ‘‘language’’, it is acquired by observation, imitation and by sharing experiences (Alwis & Hartmann, 2008, 133 - 147). We can see tacit knowledge as when one does not depend on technical formulas again to take an action. “It is for example to be able to cook without a recipe or to have an intuitive feeling of the right decision” (Haldin-Herrgard, 2000, 357 - 365). “Tacit knowledge is personal, co text-specific and therefore hard to formalize and communicate” (Norman, 2005, 104 - 113). As we can see easily there are many definitions of tacit knowledge but the one given by Polanyi in 1969 is widely seen by scholars as the root of the concept of tacit management. He summarized it all in one sentence “we know more than we can tell” and gave examples like how we can recognise faces, ride a bicycle, without being able to explain how we are able to do this things (Alwis & Hartmann, 2008, 133 - 147).

3.2.2 Explicit Knowledge

Contrary to tacit knowledge, explicit knowledge can be coded and stored. It is a type of knowledge that is integrated in a code or language and already documented in a formal format (Ronald & Uday, 2007, 94 - 109).

3.2.3 Tacit \ Explicit Knowledge

Taking only one type in consideration will definitely be a big mistake since tacit and explicit knowledge are both complementary and in between them we have implicit knowledge. “Knowledge can be seen as a spectrum where at one extreme end we find the completely tacit and unconscious knowledge and at the other end

the completely explicit, structured and coded knowledge. In such a dualist framework tacit and explicit is juxtaposed or co-existing in a synergetic relationship" (Haldin-Herrgard, 2000, 357 - 365). In other words, explicit knowledge is the process that deals with the organization of knowledge where on the other hand tacit knowledge is the practical aspect that refers to how the work is done (Krishna & Busch, 2012, 357 – 372).

3.3 Role of Knowledge Management in an Organization

For decades, knowledge has been considered as an important asset for the organisation, therefore its good management is directly proportional to the organization success. This has led researchers all over the world to conduct studies in order to see what the real contribution of knowledge management is in managing organisation's knowledge (Nevo & Chan, 2007, 583 – 597). Scholars and researchers from disciplines as distinct as sociology, economics, management science, and engineering all together agree that a change has taken place; "knowledge" is now at the centre stage.

Today's economy and business world are experiencing a huge shift due to globalisation and other factors. Companies now have to deal with more customers and partners all over the world, new technology, environmental issues, political changes etc. Therefore to be able to stay at the top, maintain their competitive advantage, an organisation must have a very good system in place that will help retain, develop, organise and make good use of their employee competencies (Mårtensson, 2000, 204 - 216).

3.4 Knowledge Management as a Management Tool

KM is most often seen as a management tool for organisations. It is considered as either an operational/process tool, or as a strategic management tool.

3.4.1 Knowledge Management as an Operational Tool

The uses of knowledge based systems software in KM have caught the attention of a lot of scholars straight from the beginning of the KM concept. This issue was addressed long before the term "knowledge management" was commonly used (Edwards, Shaw & Collier, 2005, 113 - 125).

Table 2 below shows the most popular artificial intelligence (AI) based and conventional based software seen by different scholars as support to KM implementation.

Table 2. AI based and conventional based software used in KM (Edwards;Shaw;& Collier, 2005, 113 - 125)

AI-based	Conventional
Case-based reasoning Data mining Expert systems Genetic algorithms Intelligent agents Knowledge-based systems Multi-agent systems Neural networks ''Push'' technology	Bulletin boards Computer-supported co-operative work Databases Data warehousing Decision support systems Discussion forums Document management Electronic publishing E-mail Executive information systems Groupware Information retrieval Intranets Multimedia/hypermedia Natural language processing People finder/''Yellow Pages'' Search engines Workflow management

There is a clear distinction between data, information and knowledge. Data put in a specific context is no longer data but information and when that information has a meaning and becomes useful to the user at a point of time it is then considered as knowledge (Bailey & Clarke, 2000, 235 - 243).

Despite having received much publicity in recent years, there is still confusion over the technological implications for KM. This is due to the way software applications under the knowledge management label have been presented.

Though KM technologies may embody characteristics of traditional data and information technologies, now they also have more extended capabilities. The available technologies nowadays make the user to think beyond their limits, hence making the organizational activities far easier, encouraging endless development and growth through innovation (Moffett, McAdam & Parkinson, 2003, 6 - 26).

Figure 1 below shows the different stages involved in knowledge management i.e. *knowledge creation, knowledge up-gradation, knowledge sharing and knowledge retention*. The good repartition and definition of these tasks at each stage is often the key to an organization success.

Figure 1. Knowledge management stages (Mishra & Bhaskar, 2011, 344 - 359)

Next, the stages of KM are discussed further.

Knowledge Creation

Knowledge creation (KC) in short is the ability to use an existing knowledge in order to come out with a totally new knowledge.

Mishra & Bhaskar, (2011, 344 - 359) defined KC as the power to generate new knowledge, to propagate it and incorporate it in products, services and systems of the organization

For them, it consists of socialization (tacit to tacit), externalization (tacit to explicit), combination (explicit to explicit), and internalization (explicit to tacit).

Knowledge Sharing

After the creation of "new" knowledge, it needs to be shared or distributed among all members of the organization or else this knowledge will have no value.

Knowledge Up-gradation

Changes happen all the time very rapidly in an organization. Therefore, it is compulsory upon the organization to upgrade or refine its existing knowledge or else that knowledge will lose it value leading to a poor performance of the organization.

Knowledge retention

This is one very important role of knowledge management. After all previous stages, the organization must have a very good system in place in order to avoid losing key skills and expert in a specific knowledge domain.

3.4.2 Knowledge Management as a Strategic Management Tool

Knowledge management is very sensible issue now for managers. This is understandable since one of its aims is to bring out a strategy to the capture, utilization and the transfer of knowledge throughout the organization, for the organization to have a better efficiency and improve its competitive edge (Moffett;McAdam;& Parkinson, 2003, 6 - 26). Therefore more and more companies and institution are working with KM in order for them to remain competitive in the market.

Scholars have been conducting many surveys to find out how many companies are implementing or planning to implement KM in their everyday activities. The surveys aim at either to bring about KM strategies or bring about measurement systems on how to measure an "intangible asset", or a mix of both (Mårtensson, 2000, 204 - 216).

Strategy from an organizational point of view can be defined as the process defined by the organization to balance its capabilities (resources and skills) with a steadily and fast changing external environment. Therefore, organizations have to make sure that their business strategies are "innovative" in order to develop and maintain competitive advantages (Du Plessis, 2007, 20 - 29). The knowledge strategy of an organization is defined by its management team in six steps. These steps move from the current business perspective of the organization for the near future, associated important performance indicators and knowledge areas in order to assess the "knowledge area state" "(as-is and to-be)" in proficiency, sharing and codification, based on the general understanding of the knowledge in the organization. Last but not the least, definition of KM actions in order for the organization to achieve the "to-be" states which defines priority knowledge area thus, reaching states-of-.the-art KM system solutions (Davenport & Probst, 2002).

Two types of resources are available in any organizations: physical resources (money, equipment, materials, facilities, and time) and conceptual resources (data, information, and knowledge) (Carneiro, 2000, 87 - 98). Therefore, it is the responsibility of managers to decide how resources will be dispatched across their organizations. Thus, they have to make major decisions and produce good results. Every decision should be based on a merged set of information and the knowledge skills of human resources. KM becomes then a very important strategic tool since it can be a key asset for decision making when formulating alternative strategies (Carneiro, 2000, 87 - 98). Organizations must then acquire a combinative approach to KM that takes into consideration all potential components of knowledge and empowers specific components strategically in accordance with the organization's business aims and objectives (Ronald & Uday, 2007, 94 - 109).

Beijerse (1999, 94 - 110) gave an exhaustive list of advantages of KM in a company:

- To improve efficiency.
- To improve the market position by operating more intelligently on the market.
- To enhance the continuity of the company.
- To enhance the profitability of the company.
- To optimize the interaction between product development and marketing.
- To improve the relevant (group) competencies.
- To make professionals learn more efficiently and more effectively.
- To provide a better foundation for making decisions like make-or-buy of new knowledge and technology, alliances and merges.
- To improve communication between knowledge-workers.
- To enhance synergy between knowledge workers.
- To ensure that knowledge-workers stay with the company.
- To make the company focus on the core business and on critical company knowledge.

He believes that KM can enable companies and organizations to remain competitive against a more and more complex business world led by the emergence of "the knowledge based-economy".

The KM and information sharing system of an organization can help the organization to meet its objectives only when good and easy to use IT tools are integrated to the organization's KM systems. Therefore, KM and technology are complementary.

In the following chapter, we will talk about one of the technologies that can be used in KM as an operational tool of any organization: QR codes.

4 QR CODES

QR codes which stand for “Quick Response codes” are 2 dimensional bar codes that can be read with the help of a mobile phone. The technology was developed in Japan in 1994 by Denso Wave (a subsidiary of Toyota Japan) in order to be able to track vehicles parts.

4.1 What is a QR Code?

QR codes are members of the big family of 2D bar codes and they can be read with a mobile phone device equipped with a camera. QR codes are open source and comply with an international standard (ISO/IEC 18004:2006).

QR Codes are becoming a very important tool for marketing purposeall over the world, and act as the link between the physical world (leaflet, brochure, newspaper) and the digital world (website, contact information and other digital information). They also make communication a lot easier (make a call, send text message and send an email). All these applications make QR codes a very good operational tool that can be used in KM.

Below are examples of generated QR codes. Figure 2 is a link to VAMK portal.

Figure 2. QR code VAMK portal.

When scanned, it opens directly to the university portal webpage.

Figure 3 below is a simple text.

Figure 3. QR code (text).

When scanned, it opens a simple text on your mobile phone that can be sent to contacts as SMS or e-mails.

Figure 4 below is a phone number.

Figure 4. QR code (phone number).

When scanned, the user can directly call the number.

4.2 Applications of QR Codes

2D bar code (QR code) is a technology which is evolving every day. The technology is widely used in Asia (Japan, South Korea, Hong Kong and China). The technology is now invading Europe and America in various sectors like education and marketing.

4.2.1 QR Codes in Education

The best example of QR codes in education so far is that of the University of Bath in the UK. The university has made QR codes an integral part of their everyday activities with a wide range of applications. They are as follow:

- QR codes in presentation material, this gives the audience a just in time information about the presentation and from where it can be downloaded on their mobile phones.
- Using QR codes for classroom feedback.
- QR codes for cover sheet submission.
- QR codes in the library.
- A student subscribing to RSS news feed.
- Inclusion within printed learning materials.

More and more educational institutions worldwide are now integrating QR codes in their everyday activities. With the increasing number of students and staff using a smart phone, this technology has a bright future in education, even though some concerns have been raised with regards to disabled students or the effect that the technology may have on how lecturers will have their classes if the technology is fully applied (Ramsden, 2008).

It is not only in education that we can find QR codes; they have many applications in other areas too.

4.2.2 Applications of QR Codes Around us

Many companies and institutions worldwide are now using 2D bar code technology for different purposes. The technology can be used in marketing, data encryption, fun and many more. For instance, to inform its customers about the nutritious value of their burgers, McDonalds now have a QR code on the burger package. New i-Pods are advertised on billboards with QR codes. QR codes appear everywhere now on business cards, T-shirts, passports, websites, magazines, etc. (Rouillard, 2008).

4.3 The Technology of QR Codes

The information on a QR code is embedded in a two dimensional matrix and is readable with mobile phone equipped with camera and 2D bar code scanner. 2D bar codes are widely spread in Asia (mostly in Japan and Korea) and are now slowly expanding all over the world. QR codes have many advantages over 1D bar codes and other 2D bar code (Law & So, 2010, 85 - 100) :

- Denso Wave who owns the patent right chose not to exercise it.
- It is an ISO international standard (ISO/IEC 18004:2000&2006). This means its specifications are open to the public all over the world through the International Organization for Standardization and in Japan through the Japanese Industrial Standards with the registered code JIS X 0510.
- High storing capacity in a small print out size and also high speed reading capacity software already available.

4.3.1 The Code Structure

The QR code is a 2D matrix bar code readable by specific QR code readers installed on any camera phones. The code is made up by black modules (the colour can vary) displayed on a square pattern with a white background. Each code is divided into two areas: the encoding region and function patterns. The main features of the code are three position finder, separator for position finder, two timing patterns and six alignment patterns. The code has on all its four sides a quiet zone to prevent error during reading (Fang, 2011, 89 - 92). Figure 5 below shows a QR codes with all its features.

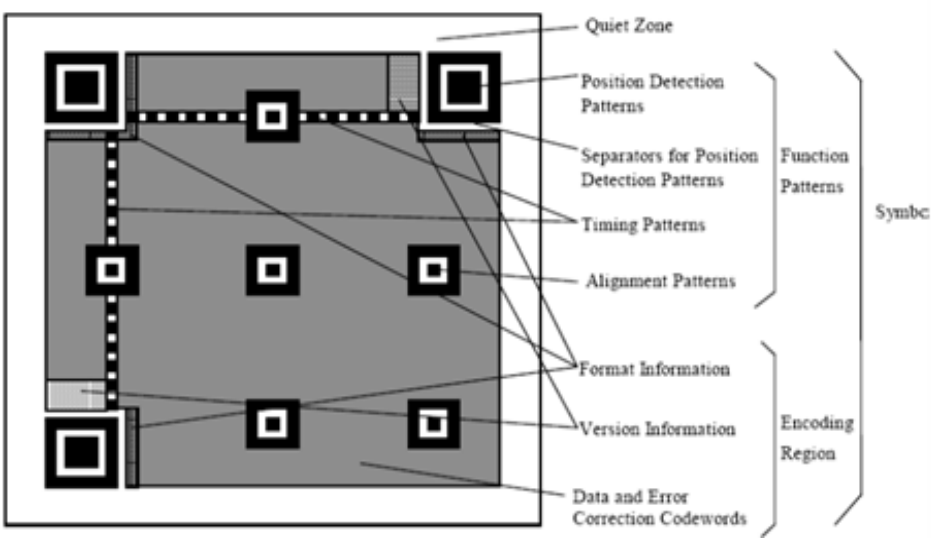

Figure 5. QR codes structure (Fang, 2011, 89 - 92).

Unlike the traditional 1D bar code which store data in its length only (the height is only for scanning purpose), QR codes store data in both its length and height which give them a much bigger data capacity than 1D bar code and any other 2D bar codes like *data matrix, PDF417 and maxi codes.* A previous study showed that in the 2D bar codes family, data matrix has a higher quality than the others (except for Japanese Kanji symbols encoding). Despite that QR codes are becoming very common all over the world particularly in Asia (Rouillard, 2008).

The codes can store up to 7,089 numeric characters, 4,296 alphanumeric characters, 2,953 binary bytes or a mixture of them (Law & So, 2010, 85 - 100). The code also has omni-direction readability and a very high automatic error correction capability (Chang, Chu & Chen, 2007, 123 - 131)

Table 3 below gives a detailed comparison between 2D bar code and 1D bar code, while Table 4 is the comparison between QR code and other 2D bar codes.

Table 3. Comparison of 2D and 1D bar codes (SYSCAN, 2010)

Bar code type	**1D**	**2D**
Information density	Low	High
Information capacity	Small	big
Information type	Numbers, Greek characters	Numbers, Greek characters, Chinese, pictures, voice and other binary information
Errors correction function	Yes	No
Dependence on database	Must depend on database or communication network	Does not depend on database or communication network
Nature	Object label & index	Description on objects

If you compare QR codes with other 2D bar codes like PDF417 and data matrix, despite having a bigger storage capacity than the others, QR codes are more appreciated due the fact that it is an open source technology (the patent right is not exercises by DENSO) (SYSCAN, 2010).

Table 4. QR code and other 2D bar codes (SYSCAN, 2010)

2D barcode type		**QR code**	**Data matrix**	**PDF417**
Layout		Matrix	Matrix	Layers (1D layout)
Developer (country)		DENSO (Japan)	RVSI Acuity CiMatrix (USA)	Symbol Technologies (USA)
Maximum capacity		3Kb	1.5Kb	1Kb
Data type	**Numeric**	7,089	3,116	2,710
	Alphanumeric	4,296	2,355	1,850
	Binary	2,953	1,556	1,018
	Kanji	1,817	778	554
Readable direction		Any angle	Any angle	Upward/Downward
Bar code shape		Square only	Square only	Any rectangle

4.3.2 Errors correction of QR codes

Thanks to its many advanced features like the *three position finder*, which do not only allow the code to be read at any possible angle, it also has a data and errors correction capability. If for instance the code is damaged, it still can be read with any mobile phone equipped with a QR codes scanner. There are four errors correction levels (Sutheebanjard & Premchaiswadi, 2010):

- Level L: approximately 7% or less error can be corrected.
- Level M: approximately 15% or less error can be corrected.
- Level Q: approximately 25% or less error can be corrected.

- Level H: approximately 30% or less error can be corrected.

4.4 Making your Own QR Code

Generating a QR has never been easier. To get his own QR code, one just needs an Internet access and open one of the QR codes generating tools available online among others like:

- Kaywa: http://qrcode.kaywa.com/for URL, phone numbers, text and sms;
- ZXing Project: http://zxing.appspot.com/generator/ for geographical location, text, contact information Wi-Fi network;
- NFC Games: http://nfggames.com/system/qrcodegen.php for text, contacts information, bookmark;
- Delivr: http://delivr.com/qr-code-generator for RSS feed Google map, Amazon affiliate link and post a tweet;
- QR Stuff: http://www.qrstuff.com/index.html for URL, YouTube video, PayPal buy now link, Facebook, Twitter and many more;
- http://invx.com/ for generating both QR code and data matrix;
- http://qrvoice.net/ for QR code sound files; (convert text to sound)
- http://www.i-nigma.com/CreateBarcodes.html for Encoded message, URL and text;
- http://www.moongate.ro/en/products/qr_code-vcard/ for Vcard;
- http://beqrious.com/qr-code-generator/;
- http://keremerkan.net/qr-code-and-2d-code-generator/;

For the purpose of this project, QR stuff will be used because it is one of the best in the market since it gives the user possibility to generate different kind of codes with different type of data.

Figure 6 below shows all the steps involved when generating a QR code using www.qrstuff.com.

In step 1, you choose the data type you would like to have on your code. Step 2 you enter the content you want to saveif it is a text your just type it, if it is a web site you copy and paste the URL etc. In step 3 you choose the colour of your code.

Figure 6. Generating QR codes with qrstuff.com

Your QR code is now ready, just click on download as shown in the picture below to save it.

Note that you can print out your code on different platform and format. Apart from these free online services mentioned earlier, there is hundreds of commercial software developed by different companies like: UPC Code, TechnoRiverSoft, Han-Soft, Aspose, etc.

2D codes are now found all around us in many different applications. As an innovative institution, VAMK decided to embark on the 2D bar code trends and integrate QR codes on its laboratories and lecture materials starting with this pilot project.

5 QR CODES IN VAMK (PILOT PROJECT)

5.1 Knowledge Management in VAMK

Like all other international educational institutions, VAMK, University of Applied Sciences has to deal every single day with tons of all kinds of data, information or knowledge. Therefore, the school is using different types of tools to have an easy knowledge and asset management system.

Figure 7 below gives an overview of knowledge management in VAMK.

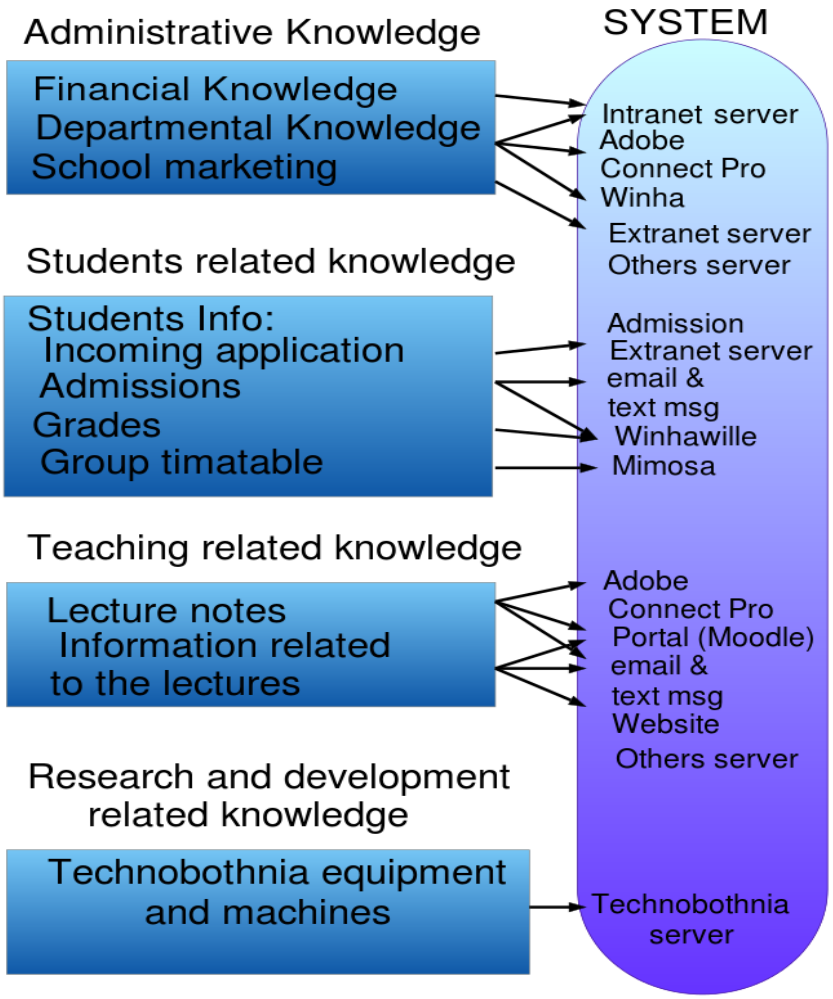

Figure 7. Overview of Knowledge Management in VAMK

We can see from the picture that the systems the school is using for its knowledge management are of all kind. For instance, it has three websites i.e. www.puv.fi for visitors who want to learn more about the university, https://portal.puv.fi/ for students who have been given admission. Every student is given a username and a password when his admission letter is issued. And finally, the university has a staff intranet (http://intra.puv.fi/) where staff members can share information and others.

The university also has much different software that is being used in the school administration and educational processes. It is from there that they have access to "Winha" which is the master program where students and courses related matters are being managed. The most important are: Winha, Mimosa, Adobe ConnectPro and Moodle, and of course MS office tools are used widely too.

Concerning Technobothnia, it is a new server and it is there that we uploaded all data and information with regards to this pilot project (http://new.technobothnia.fi/en_GB/web/12595/home;jsessionid=C891C24FCDB8165FC321CCE0816CEE94)

All three section of this project were done simultaneously. The survey is dealt with in chapter 5.3, QR codes in TB research centre in chapter 5.4 and QR codes in Finnish for foreigners' language learning material in chapter 5.5

5.2 Project Process

Figure 8 below is an overall picture of this pilot project.

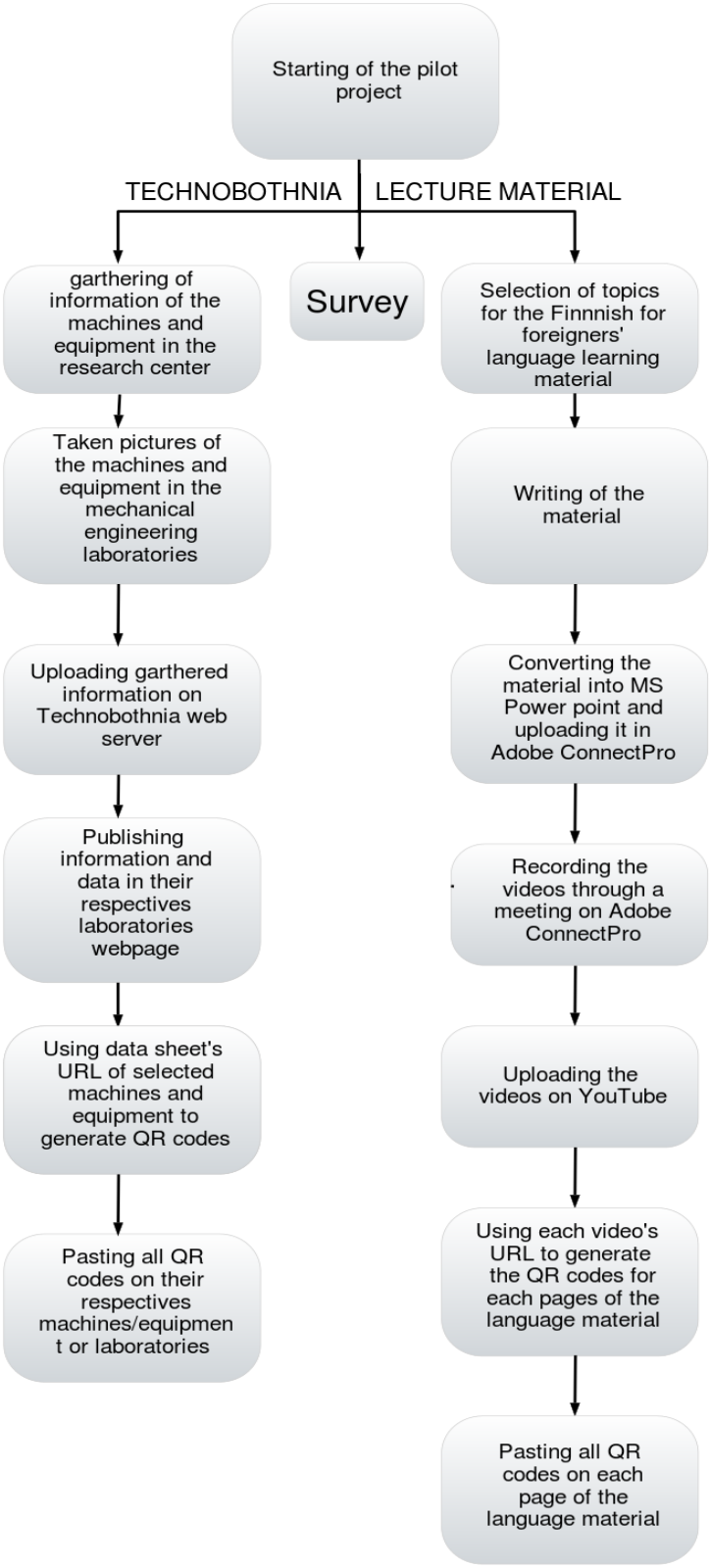

Figure 8. General view of the pilot project.

5.3 Questionnaire

For the purpose of this project, a survey was done through a questionnaire which was developed and shared to students of different departments in the university by lecturers during classes. The objective of this small survey was to see how familiar the students are with the 2D bar code technology. Since this is just a pilot project, a very small population of the school has been considered.

5.3.1 Overview and Sample

In all, 150 copies of the questionnaire were given to different lecturers from different departments for them to share it to their students; these represent only 4.44% of the total students' population. The lecturers distributed the questionnaires during one week. From the 150 copies, 103 were answered giving a response rate of 68.66%. Even though this is a very small population compared to the total number of students in the school, but the fact remains that the results we got from the students tell it all. Students are not well familiar with this technology and it is understandable since it is a pretty new technology. The results were entered in Microsoft Excel for analysis.

The questionnaire for this survey will be provided in Appendix 1 and the data will be provided in Appendix2.

5.3.2 Data Analysis

First, students were asked about their gender. From the answers we had 77% male and 23% female respondents. The difference may be due to the fact that the departments selected were all engineering departments which most often are populated by males.

The second question was about the students' department and the results are shown in Figure 9 below.

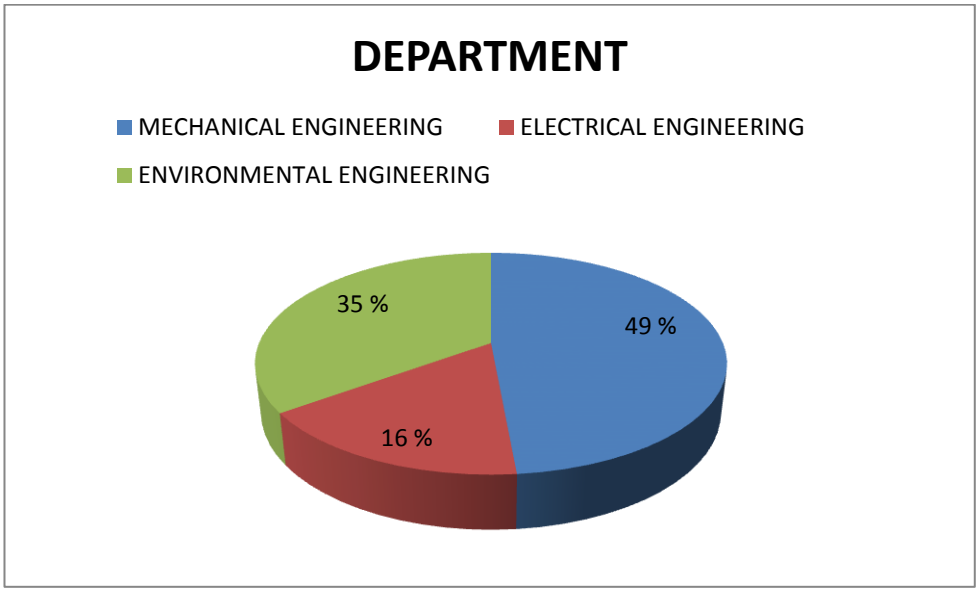

Figure 9. Departments

The questionnaire was only distributed to student in the Palosari campus where three departments were selected and 49% of the respondents were from the mechanical engineering department, 16% from the electrical engineering department and the remaining 35% from the environmental engineering department.

The third question was about the type of phone students are using. They were asked if they have a smart phone or a phone equipped with camera. The results are shown in Figure 10 below.

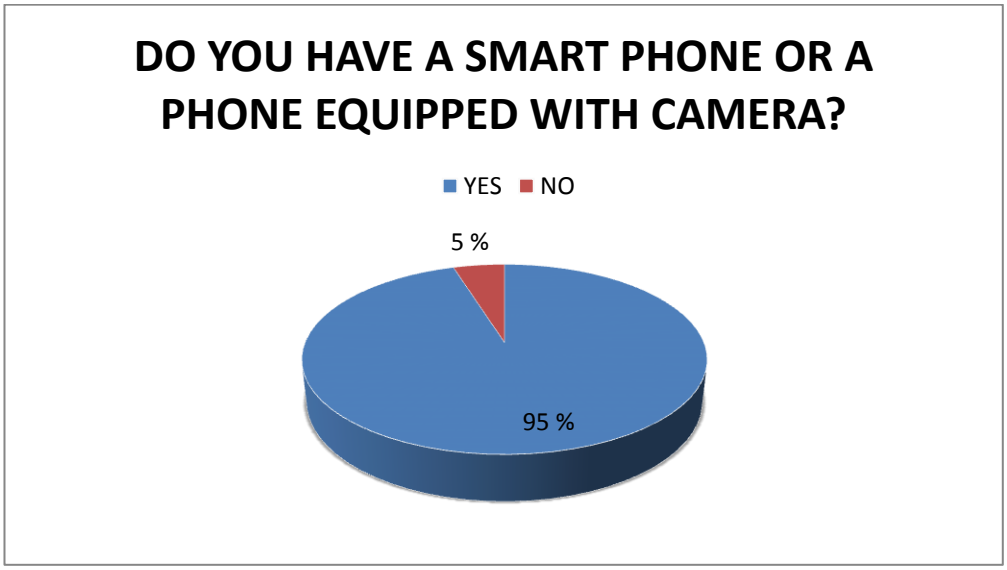

Figure 10. Types of phones used by students

95% of the respondents said they have and only 5% of them do not have a smart phone or a phone equipped with camera. This shows that students have what is needed to use 2D bar codes technology.

The fourth question was to find out if they have ever seen or heard of 2D bar codes. Figure 11 below shows the results.

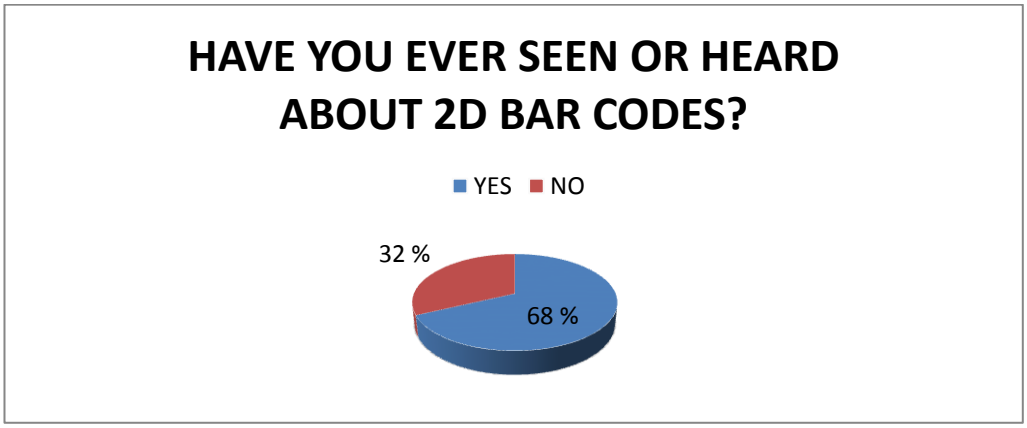

Figure 11. Familiarizing with 2D bar codes.

68% said Yes against 38% saying they have never seen or heard of it. This shows that, the majority of the students are already aware of the existence of that technology.

In the fifth question, students were asked where they have seen a 2D bar code. Figure 12 below shows the results.

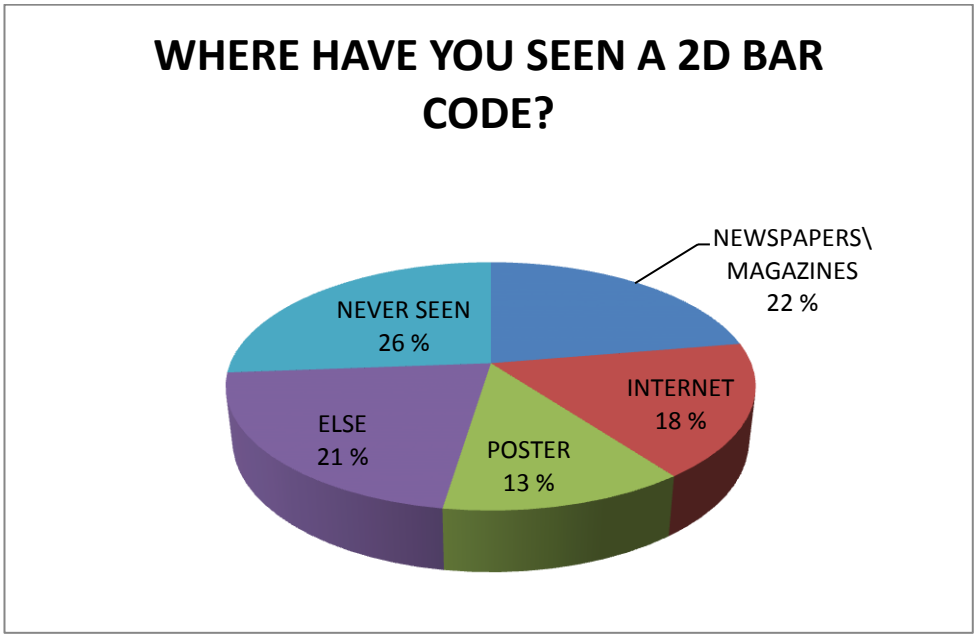

Figure 12. Where the codes are seen

27 students representing 26% of respondents claimed they never seen any 2D bar code, 23 (22%) of them saw it in newspaper\magazines, 18 (18%) students saw it through the Internet, 13 (13%) on a poster and 22 (21%) of them saw it somewhere else. From these results we can see that even though 2D bar codes are found everywhere nowadays, a lot of students have not had the opportunity to actually see them.

Question 6 was to find out if the students ever scanned 2D bar codes in their life. The results are shown in Figure 13 below.

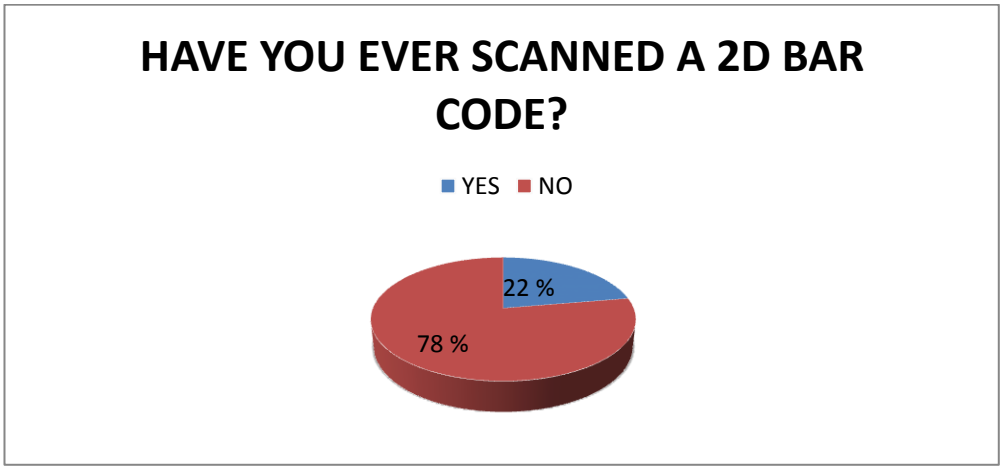

Figure 13. Have you ever scanned a bar code?

Only 22% of the respondents said Yes with the remaining 78% saying No. These results show that despite having smart phones, using them for scanning 2D bar codes is not general.

Question 7 was about the frequency at which students scan 2D bar codes. The results are shown in Figure 14 below.

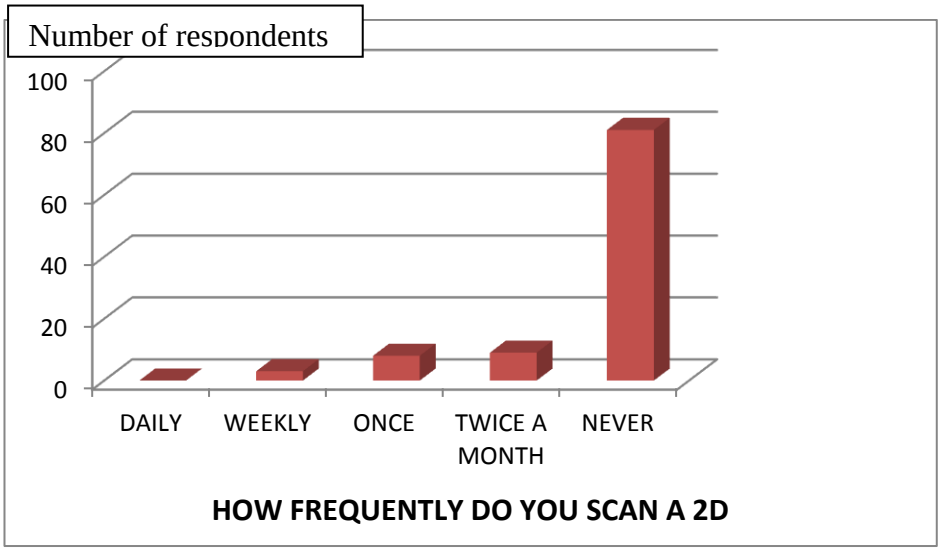

Figure 14. Students scanning frequency

Three of the respondents claim to do it weekly, nine twice per month, eight saying they scanned it only once in their life and not surprisingly 81 of the students saying they have never scanned any 2D bar codes in their whole life.

Finally, the last question was to see if students have a 2D bar codes reader on their mobile phones, Figure 15below shows that 5% did not know if they have it or not, 14% said that they have it and a big majority of 81% said that they do not have it at all.

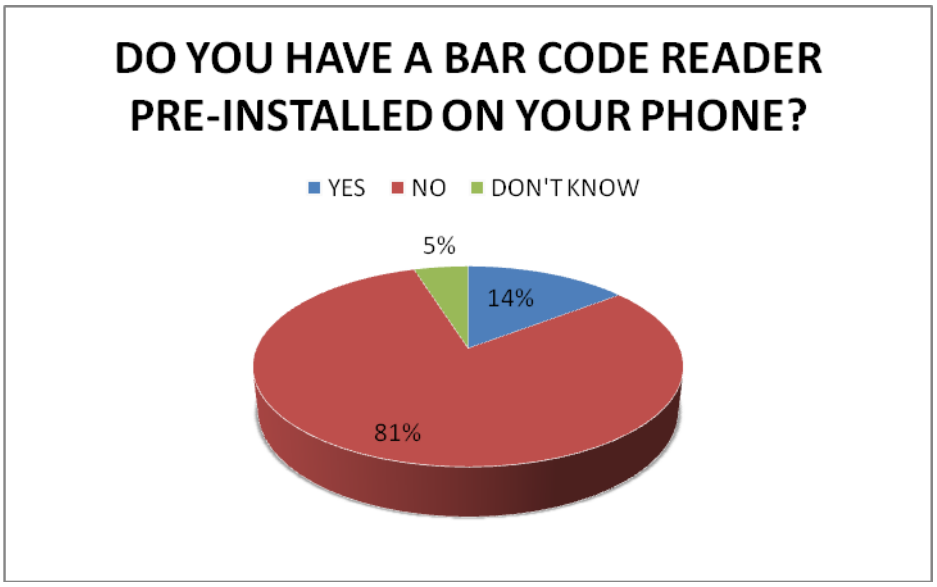

Figure 15. Codes reader on the student phones

In all, eight questions were asked from the students, and looking at all the answers collected, we can see that despite having the required technology for scanning, students do not frequently scan the codes or have the reader installed on their mobile phones. Therefore, the need to educate them on 2D bar codes and its applications in education and other areas is really high. There should be more projects like this so that students will be more aware of 2D bar code technology.

5.4 QR Codes in Technobothnia Research Centre

Shared by three universities in Vaasa, Technobothnia research centre has to deal with all kind of information and data flows. Therefore integrating 2D bar code technology in the research centre knowledge management will not only help the management team in monitoring asset performances and maintenance reports but also visitors will now have access to the specifications and description of a specific machine in a laboratory using their mobile phones.

Since this is a pilot project only the laboratories from the mechanical engineering department were taken into consideration. All the generated codes will be provided in Appendix 4.

At least one QR code was generated for each of the following laboratories in the research centre: Robotics, Machine Automation, Materials Technology, CAD\CAM, Pneumatics and Hydraulics, and finally Quality Technology lab.

We started by gathering all necessary information concerning all the machines and equipment in the above mentioned laboratories. Some of the machines and equipment description and data sheet were given to us by different lecturers in charge of the laboratory but most of them were got through manufactures' websites. At the same time, pictures of the machines and equipment were taken in the different laboratories and "gif animated" pictures were made for each machines using "Falco gif animator" software.

Pictures, descriptions, and data sheets of the machines and equipment were then uploaded to the Technobothnia server before adding and publishing them on their respective laboratory web pages on Technobothnia new website http://new.technobothnia.fi/en_GB which is where all the codes will be linked.

The new Technobothnia websites is powered by Net-Challenge using Life Ray technology to develop the website. Net-Challenge is an EU research project dealing in SMEs collaborative business network area.

The website is designed with a simple user interface. Figure16 below shows the home page of the websites. The site consists of four layers, in layer 1 you have four available sections: Energy Chain, Energy IT, Energy efficient construction and Energy technology production (which the section on which we worked for this project).

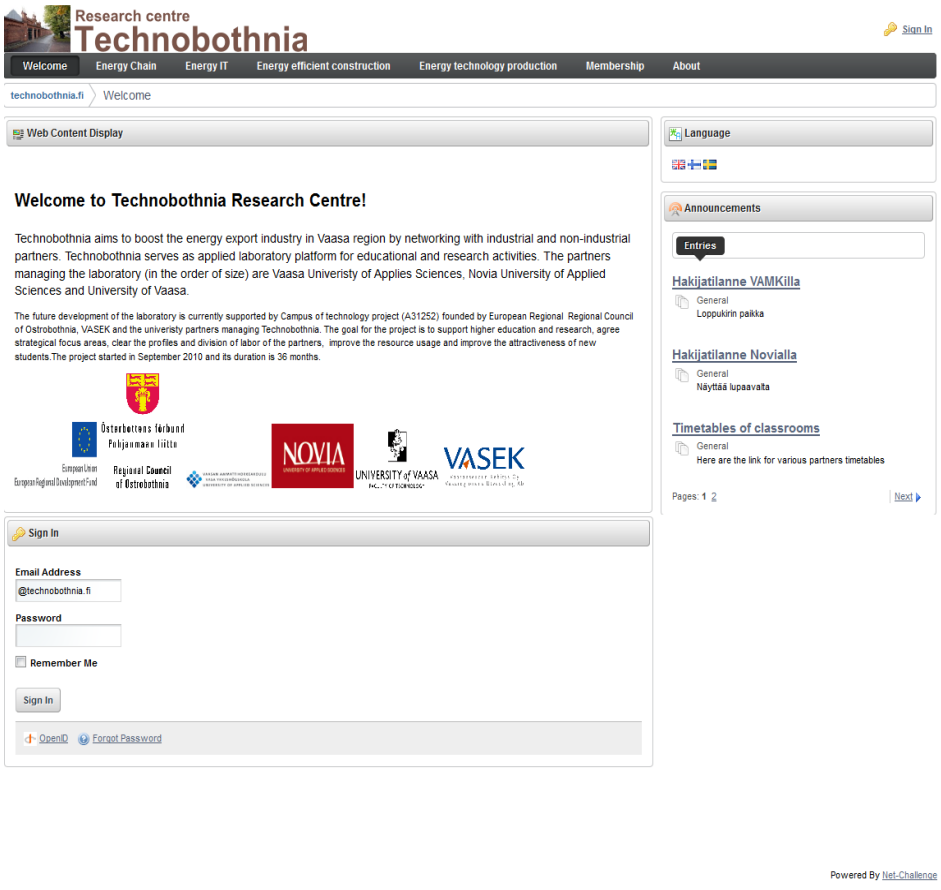

Figure 16. New Technobothnia website homepage

Clicking on any of the above mentioned section (Energy technology production in this case) takes us to layer 2 where we have the laboratories, services, research and innovation, industry advisory board and industry collegiums. The next layer is 3 where we have the laboratories, and the laboratories in layer 3 are:

Robotics, Machine Automation, Materials Technology, CAD\CAM, Pneumatics and Hydraulics, Quality Technology, Mechanical engineering project area, metal workshop, Motor, Vehicle, Dynometric and Energy lab.

Table 5 below shows all the laboratories found in layer 3 and lecturers in charge of them.

Table 5. Laboratories in layer 3 of the website

ID	**Laboratory**	**Responsible**
LMAA	Robotics	Mika Billing
LMMA	Machine automation	Marko Rantasalo
LMMT	Material technology	MattiMakkonen
LMNC	CAD/CAM	Pertti Lindberg
LMPH	Pneumatics and hydraulics	Timo Gröndahl
LMQC	Quality technology	Hannu Hyvärinen
LMRD	Mechanical engineering project area	Osku Hirvonen
F4P15b	Metal workshop	Markku Kuusinen
F4P18	Motor	Olav Nilsson
F4P19	Vehichle	Lars Backlund
F4P23	Dynometric	Lars Backlund
F4P54	Energy	Gammelgård A

Layer 3 is where we have the list of all the machines and equipment of each laboratory. Figure 17 below shows how layer 3 looks like. The robotics laboratory has been taken for illustration and we can see the list of robots found in the laboratory, a short description of each robot and links to the data sheets and manuals of the robots.

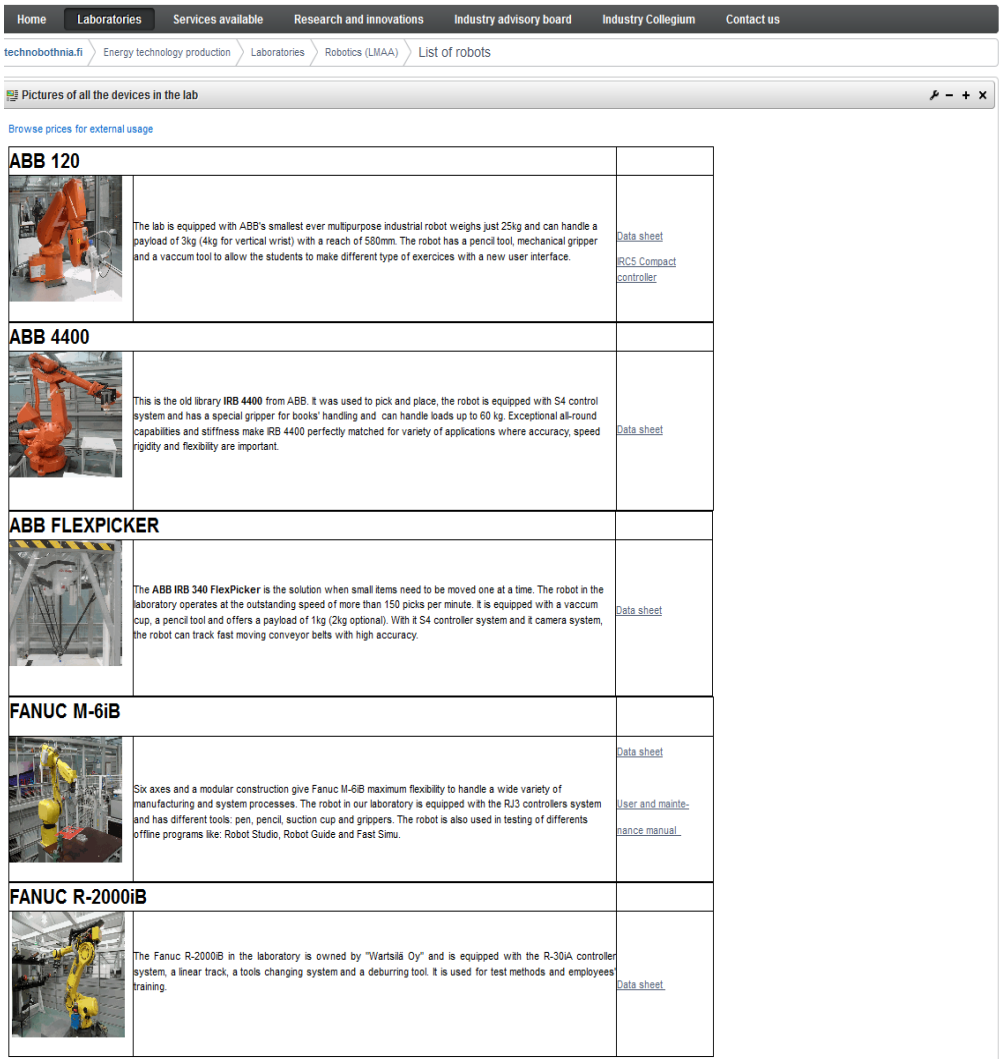

Figure 17. List of robots in the robotics lab

The links to the data sheet will therefore be used for generating our QR codes. For instance the link to the data sheet of the ABB's IRB120 .i.e. http://new.technobothnia.fi/en_GB/c/document_library/get_file?uuid=fa1abe71-cec4-4490-b68d-1f4c0deca9b7&groupId=23129 will be used to generate the QR codes that will be pasted on the robots in the lab so that anyone having a smartphone can have access to basic information regarding that robot. And this will be useful for visitors coming to the lab; they do not have to wait for the lecturer in charge to have some information about the robot.

Figure 18 shows the first page of the data sheet of the ABB's IRB120 and this is what you see when you scan the code while Figure 19 shows the ABB's IRB120 with the QR code linking to its data sheet.

Figure 18. Data sheet seen after scanning the code

The same procedure was done for each machine or equipment in the mechanical engineering laboratories. A QR code was generated using the lab webpage or a machine's data sheet URL of the machines. As mentioned earlier, the codes can be generated online with the help of one of the many free available code generators websites. For this project, we used www.qrstuff.com to generate our codes. After the codes have been generated, they were printed on A4 sheet, laminated and then, pasted on their respective machines and laboratories entrance. See Figure 19.

Figure 19. ABB IRB120 with QR code linking to its data sheet

5.5 QR Codes in Lecture Material

The second part of this project dealt with 2D bar codes in language learning material. 2D bar codes have a bright future in education with a lot of applications which will make life easier for everybody from the administration down to the students. One of these applications is the integration of QR codes in lecture materials.

Finnish for foreigners' language learning material was developed for this project with the participation of Henrik Niemelä who is a senior language lecturer in VAMK and Lotta Saarikoski who is the Head of the Mechanical and Production Engineering Department and also supervisor of this pilot project.

The handout was written in a clear and simple way, given the reader an easy description and understanding of some aspect of the Finnish language like: the alphabet, numbers, asking for help and direction. There is also a dialogue taken place in a shop between a customer who wants to buy some fish and the seller. A copy of the handout will be attached in Appendix 3.

The particularity of this lecture note is that a QR code is embedded on each page. The file is in video format given the reader the privilege to listen (using his mobile phone) to the pronunciation of each words and letters on that specific page as he reads. The reader does not need to insert a CD on his computer anymore.

The material was prepared by Abdoul-Hafeez Mounguengui Bello, and the video recordings were made by Henrik Niemelä, and Lotta Saarikoski. The software used to make these videos is Adobe ConnectPro. The full lecture material was first converted as MS Power Point and then uploaded on AdobeConnectPro where the three readers mentioned earlier on had a meeting which was then recorded.

In order to do the recordings, a meeting on Adobe ConnectPro was hosted by Lotta Saarikoski (she acted as voice 1) and Henrik Niemalä was participant and acted as voice 2. During the meeting, the recordings were done in this order and by both of them.The alphabet, pronunciation (vowels and consonants), numbers, greetings

and asking for help and directions, introducing yourself, personal pronoun, groceries products, and last but not the least, the dialogue with Lotta as the customer and Henrik as the seller.

When the recordings were done, the videos were uploaded on a YouTube account. The URLs of the differentvideos were used to generate the QR codes online on http://www.qrstuff.com/. Each code was then copied and pasted on their respective page of the hand-out. All generated codes can also be seen in Appendix 3.

6 CONCLUSION AND RECOMMENDATION

Even though 2D bar codes have been in used for many decades, it has never been a hot research topic as it is nowadays. The technology has a firm ground in Asia and is now coming to America and Europe. More and more companies and institutions are now integrating 2D bar codes in their everyday business activities making their KM easier. As we have seen in this thesis that the quality of the KM base of an institution depends on the technology they use.

Despite having well advanced KM systems at VAMK, University of Applied Sciences, there is still room for development and the integration of new IT tools like 2D bar codes which can make life easier for both students and lecturers with all its applications in a classroom and laboratories.

Since this was just a pilot project, we only focused on two areas in which we integrated QR codes, firstly in Finnish for foreigners lecture note and secondly in the mechanical engineering laboratories in Technobothnia. For future studies, one can work on a whole lot of new applications like integrating 2D bar codes to Moodle, having 2D bar codes on power point presentations, 2D bar codes in all the laboratories in Technobothnia research centre and many more.

More and more sophisticated mobile phones and touch Pads are being produced today. People tend more than ever to use their mobile phones and other portable devices instead of their laptop or desktop to go online and make all kind of transaction. Therefore, the need to link the physical world to the digital world is all the time increasing since people want to have access to the Internet anywhere and anytime. Thus, 2D bar codes will in the near future if not now become a necessary IT tool.

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Questionnaire related to the use of 2D codes

Hi, this is a questionnaire related to my final thesis. Can you please use some minutes of your time and answer the following questions by choosing the right answer and circle it. Thank you for your time!

1. Gender
   Male Female
2. Department :
   IT Eng Mechanical Eng Electrical Eng Civil eng
   Environmental Eng Social and healthcare International business
   Business administration Tourism IT business.

3. Do you have a smartphone or phone equipped with a camera?
   Yes No

4. Have you ever seen or heard of 2D code?
   Yes No

5. Where have you seen a 2D code?
   Newspapers/Magazines Online Poster Else
   ……

6. Have you ever scanned a 2D code?
   Yes No

7. How frequently do you scan a 2D code?
   Daily Weekly Monthly Once
   Never

8. Do you have a bar code reader pre-installed on your phone?
   Yes No

Kysely liittyen 2D koodien käyttöön

Hei, tämä kysely liittyy päättötyöhöni. Voitko ystävällisesti käyttää tämän vastaamiseen muutaman minuutin ajastasi. Valitse seuraavista kysymysvaihtoehdoista sopivin ympyröimällä vastauksesi. Kiitos avustasi!

1. Sukupuoli

   Mies Nainen

2. Koulutusala :

   IT Engineer Koneinsinööri Sähköinsinööri Rakennusinsinööri

   Ympäristöinsinööri Sosionomi Sairaan/terveydenhoitaja International business

   Tradenomi Restonomi IT-tradenomi

3. Onko sinulla älypuhelin tai kameralla varustettu puhelin ?

   Kyllä Ei

4. Oletko koskaan nähnyt tai kuullut 2D koodeista?

   Kyllä En

5. Missä olet nähnyt 2D kooodin ?

   Sanomalehdessä/muussa lehdessä Nettisivuilla Julisteessa/esitteessä

Muualla, missä _____

6. Oletko koskaan skannannut 2D koodia ?
   Kyllä En

7. Kuinka usein skannaat 2D koodeja ?

   Päivittäin Viikottain Pari krt. kuukaudessa Kerran En koskaan

8. Onko sinulla asennettuna viivakooodinlukijapuhelimessasi ?
   Kyllä Ei Entiedä

APPENDIX 2: Questionnaire's data

Question 1: students' gender

GENDER	
MALE	**FEMALE**
79	24

Question 2: departments

DEPARTMENT		
MECHANICAL ENGINEERING	**ELECTRICAL ENGINEERING**	**ENVIRONMENTAL ENGINEERING**
50	17	36

Question 3: Do you have a smartphone or phone equipped with a camera?

DO YOU HAVE A SMART PHONE?	
YES	**NO**
98	5

Question 4: have you ever seen or heard about 2D bar codes?

HAVE YOU EVER SEEN OR HEARD ABOUT 2D BAR CODES?	
YES	**NO**
70	33

Question 5: where have you seen a 2D bar code?

WHERE HAVE YOU SEEN A 2D BAR CODE?				
NEWS PAPERS\MAGAZINES	**INTERNET**	**POSTER**	**ELSE**	**NEVER SEEN**
23	18	13	22	27

Question 6: have you ever scanned a 2D bar code?

HAVE YOU EVER SCANNED A 2D BAR CODE?	
YES	**NO**
23	80

Question 7: how frequently do you scan a 2D bar code?

HOW FREQUENTLY DO YOU SCAN A 2D BAR CODE?				
DAILY	**WEEKLY**	**ONCE**	**TWICE A MONTH**	**NEVER**
0	3	8	9	81

Question 8: do you have a bar code reader pre-installed on your phone?

DO YOU HAVE A BAR CODE READER PRE-INSTALLED ON YOUR PHONE?		
YES	**NO**	**DON'T KNOW**
15	83	5

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FINNISH FOR FOREIGNER'S LANGUAGE LEARNING MATERIAL WITH QR CODES

By

Lotta Saarikoski

Henrik Niemelä

Abdoul-Hafeez Mounguengui Bello

PREAMBLE

Finnish language is a very complex one, and with the number of foreigners coming to Finland increasing every year, people are becoming more and more interested in it. A lot of Finnish for foreigner's language learning materials have been published and can be found online. Despite having all these learning materials in the market, there is still a need for a self-learning material where the reader can read and at the same time listen to the written material with the help of a smart phone, not needing to have a computer or some audio device like a CD player to easily get familiar with the language pronunciation.

This hand-out was developed as part of my bachelor degree final thesis in VAMK themed "Use of QR codes in VAMK". With the participation of Henrik Niemelä who is a senior language lecturer in VAMK and Lotta Saarikoski who is the head of the mechanical and production engineering department and also supervisor of this pilot project.

The particularity of this language learning material is that a QR code is embedded on each page. The file is in video format given the reader the privilege to listen (using his mobile phone) to the pronunciation of each words and letters on that specific page as he reads. The reader does not need to insert a CD on his computer anymore. When scanned, each QR code opens a video on YouTube. The video is the recording of the page contents.

Abdoul-Hafeez Mounguengui Bello

Contents

ALPHABET

There are 29 letters in the Finnish language alphabet:

LETTER	EXAMPLE 1	EXAMPLE 2
a [aah]	AUTO	AAMU
b [beeh]	BENSIINI	
c [seeh]	CELSIUS	
d [deeh]	DESIBELI	
e [eeh]	ELÄIN	EEVA
f [æf]	FAARAO	
g [ge:]	GRAMMA	GIGA
h [hooh]	HEVONEN	
i[ee]	ILMA	IITTALA
j [yee]	JUNA	JEEPPI
k [kooh]	KALA	KANNU
l [æl]	LAIVA	PULLO
m [æm]	MAITO	TUMMA
n [æn]	NEULA	ANNI
o[ooh]	OMENA	OPPERA
p[peeh]	PERUNA	KUPPI
q [kuuh]	QUEBEC [KEBEK]	
r [ær]	RADIO	MURRE
s [æs]	SUKKA	SUKLAA
t [teeh]	TALO	TEE
u [oo]	URAANI	UUNI
v[veeh]	VENE	
w [ve:], [kaksoisve:]	WATTI	
x [æks]	XEROS	
y [eew:]	YDIN	YYTERI
z [zed]	ZORRO [TSORRO]	
å [o:]	ÅMAN [OOMAN]	
ä [æ:]	ÄITI	ÄÄNI
ö [ø:]	ÖLJY	ÖÖLANTI

http://www.youtube.com/watch?v=nem94I_gnK0

FINNISH FOR FOREIGNER'S LANGUAGE LEARNING MATERIAL QR CODES

Figure 20 ALPHABET	Figure 21 VOWELS	Figure 22 CONSONANTS
Figure 23 NUMBERS 1-16	Figure 24 NUMBERS 17-10000	Figure 25 GREETINGS AND PHRASES
Figure 26 GOOD BYE	Figure 27 ASKING FOR HELP	Figure 28 INTRODUCING YOURSELF
Figure 29 INTRODUCING YOURSELF2	Figure 30 PERSONAL PRONOUNS	Figure 31DAYS OF THE WEEK

 Figure 32 MONTHS OF THE YEAR	 Figure 33 GROCERIES 1	 Figure 34 GROCERIES 2
 Figure 35 GROCERIES 3	 Figure 36 GROCERIES 4	 Figure 37 GROCERIES 5
 Figure 38 DIALOGUE		

QR CODES IN TB

 Figure 20 ABB IRB4400	 Figure 21 CAD CAM LAB	 Figure 22 FANUC R2000IB
 Figure 23 ABB IRB120	 Figure 24 ROBOTICS LAB	 Figure 25 MECH LAB