THE CYPRUS JOURNAL OF SCIENCES

PUBLISHED BY AMERICANOS COLLEGE

VOL. 3 / SPRING 2005

The Cyprus Journal of Sciences
The Journal of Americanos College

The Cyprus Journal of Sciences

2005 Vol. 3

CONTENTS

The Cyprus Journal of Sciences
2005 Vol. 3

Economics, Management and Information Technologies

From the Editor

Dear Readers and Contributors, with your firm support our Journal has been established in the area of Academic Journals. I acknowledge the worthy contribution of all the authors. Their commitment to science and society has been expressed in variegated forms throughout the development of this academic Journal edition.

A special thank you is extended to the many academics who consciously serve in the Editorial Board. Appreciating the role of the Editorial Board for the successful development of our Journal, in this current edition the Editorial Board is enriched with the participation of new academics. Namely, Andreas A. Jobst of London School of Economics U.K., Athanasios Laios of Democritus University of Thrace, Greece, David Cooper of the University of Salford, U.K., Eleni Berki of the University of Jyväskylä, Finland and Jan Katherine Bamford of the London Metropolitan University, U.K.

The Journal formerly titled *Journal of Today*, reiterating its commitment to its readers, contributors and to the role that wishes to play in the area of sciences is named *The Cyprus Journal of Sciences* as from this edition. I believe that this new title represents the published articles more precisely and reflects the vision of all its contributors.

In this edition, once again an impressive variety of articles is presented that should be of interest to readers for their insights into theoretical issues in various scientific areas, their innovative methodologies and the substance of their findings. The published articles focus on current and popular issues in the areas of Humanities and Social Sciences, Pure and Applied Sciences, Economics, Management and Information Technologies. I truly believe that you will find them interesting.

To all the contributors and readers of *The Cyprus Journal of Sciences* I express my appreciation, my best and warmest wishes.

Charalambos Louca

The Cyprus Journal of Sciences, Vol. 3, 2005/1-18

THE CHANGING FACE OF SCIENCE EDUCATION: PREPARING SCIENTIFICALLY LITERATE CITIZENS OF TOMORROW

SUZANNE GATT*

ABSTRACT

Science has social implications. Educating students in science involves more than the acquisition of 'facts' or the development of investigative skills. If students are to become independent and responsible citizens, they need to be capable of understanding scientific issues and their impact on society. An argument will be put forward in favour of a science education that considers the social implications of scientific activity on both a local and global scale. Teachers need to change traditional teaching methods to more innovative activities that are more child-centred and take into consideration the social and ethical aspects of the scientific enterprise.

Keywords: Science education, social aspect pedagogy, citizenship

1. INTRODUCTION

The 21st century has brought with it new scientific advancements that keep pushing the boundaries of science and scientific knowledge. Two such scientific activities that have been current issues in the news on a global scale are cloning and genetically modified organisms (GMOs). In cloning we find that advances have moved on from DNA cloning which involves the transfer of a DNA fragment from one organism to a self-replicating genetic element, to reproductive cloning where an animal that has the same nuclear DNA as another currently or previously existing animal is generated, to therapeutic cloning also called "embryo cloning," that involves the production of human embryos for use in research. The goal of this latter process is not to create

* Lecturer in Primary Science and Environmental Education, Faculty of Education, University of Malta

cloned human beings, but rather to harvest stem cells that can be used to study human development and to treat disease. There have been requests by scientists to governments to allow research in this area. The main area of research is within therapeutic cloning where scientists want to study the possibility of using stem cells to clone human organs which can then be used for transplants. This would do away with the problem of finding a matching organ and increase the percentage success for transplants as the probability of rejection would be much less. Similarly, advances in biotechnology have led to the production of genetically modified organisms produced by a special set of technologies that alter the genetic makeup of living organisms as animals, plants, or bacteria. Genetically modified products include medicines and vaccines, foods and food ingredients, feeds, and fibers. Such advancements have helped farmers improve the quality of their crop and increase their produce. There have been however, concerns in that it is as yet unknown if such organisms are harmful to human health. The effect of cross pollination between genetically modified organisms and natural organisms is as yet unknown as is their impact on the ecosystem. GMOs also bring with them dominance in the market by industrialized countries, introducing monopolies that make developing countries uncompetitive, thus contributing to increasing global inequalities of wealth that already exist.

Science today is much more part of the layman's life than it was a few decades ago. The greater penetration of media, particularly T.V. and that of the internet, have all been instrumental in bringing scientific advancement into the sitting room of each and every household. In fact, cloning and genetically modified organisms made the news headlines a number of times in international media. Issues and debates about scientific research thus are no more only a concern of scientists and those directly involved in it. It has now become the responsibility of each and every citizen across the globe. Gone are the days when ordinary people were kept ignorant of scientific research and development. Citizens today have access to knowledge created across the world. This knowledge brings with it a responsibility for each and every individual. Citizens today should feel empowered and consequently should hold opinions about issues, sometimes also taking action if necessary in different ways to influence activities and initiatives being taken locally and globally. They can do this through exercising their rights like voting, participating in protests and by adopting particular lifestyles. However, in order

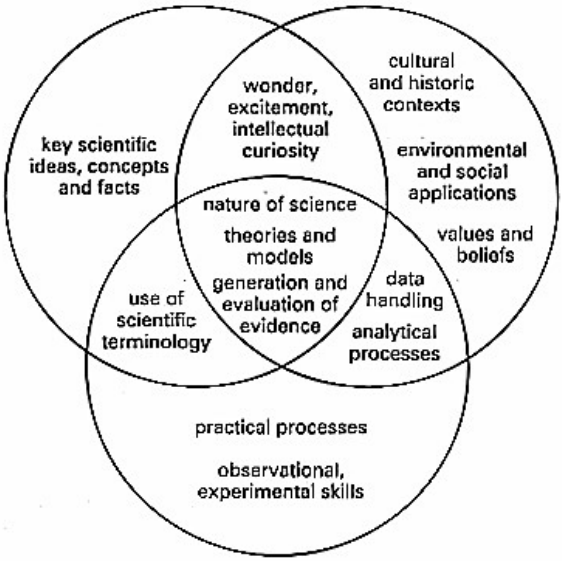
to be able to do this, citizens need to be educated in science that would enable them to understand scientific and technological issues.

2. THEORETICAL BACKGROUND

So what does it mean to do science for citizenship? Science education across the world has gone beyond the mere transmission and acquision of knowledge. Students also experience the scientific method through laboratory work and investigations. Laboratory work is today an established part of students' education in science. However, process and content do not encompass all that science education should provide. Many proponents in science (Driver *et al.*, 1996; Durant *et al.*, 1989; Miller, 1983; Wynne, 1990) agree that the public understanding of science involves at least three aspects:

- *An understanding of some science content.* This refers to scientific facts, laws and theories that make up scientific knowledge;
- *An understanding of the scientific approach to enquiry.* This does not only involve an understanding of science investigations and the process it involves but also of the role of theoretical and conceptual ideas in interpreting outcomes of investigations;
- *An understanding of science as a social enterprise.* This includes the human and institutional aspect within which science develops (Driver *et al.*, 1996).

FIGURE 1: ELEMENTS OF SCIENCE



Source: (Ratcliffe, 1998, p.8)

Mary Ratcliffe (1998) provides a wider framework for the contribution of these three aspects. She portrays the three main components of science: scientific concepts (content); practical processes, observational, experimental skills (process); and values and beliefs, cultural and historical contexts, social and environmental issues (attitudes) as overlapping. The intersection of the three components provides students with a view of the nature of science. Science education has so far focused on the transmission of content and the process of doing science. Alas, the third aspect of values and beliefs has been somewhat neglected. It is only recently that science educators have turned their attention to the social and ethical implications of science as a response to the hype produced in the media by research activities such as those in the area of cloning and GMOs.

However, before moving on to look at ways through which science can contribute to citizenship, one needs to revisit the meaning of citizenship on a local and global level. Isin and Wood (1999) state that citizenship can be described both as a set of cultural, symbolic and economic practices as well as a bundle of rights and duties. They argue that it is important to recognize both aspects and that many rights often arise from practices which later earn the

status of laws. Schmitt-Enger (2004) defines active citizenship as the capacity of citizens to self-organise in a multiplicity of forms for the mobilization of resources and the exercise of powers for the protection of rights to achieve the end of caring and developing common good. Science today forms an integral part of our everyday life. The economy of a country often depends on it. Our quality of life depends on it. As active citizens, individuals have both powers and responsibilities. They thus have the responsibility to decide about scientific issues, to exert pressure on governments to change policies that they do not agree with, to introduce laws that protect life, and human health and lifestyles. Citizens today are empowered with the option of taking action about issues and consequently they need to possess particular skills and attitudes. This can only be achieved if students are given a science education that enables them to understand social issues related to scientific activity and research. It is only through scientific literacy with an emphasis on social issues that one can have active citizens.

How science is related to citizenship or how do citizens use science? Jenkins (1997) identifies a number of features in an individual that is an ordinary citizen's, approach to science: These features include:

- *Interest in science that is differentiated by science, social group and gender*: Different groups show different inclinations in interest. For example, women tend to be more interested in issues related to medicine than to physical sciences.
- *Interest that is linked to decision-making and action:* Individuals may only be interested in particular aspects of science because they happen to be related to some decision or action they want to take. For example, they would be interested in telecommunications because they want to decide what type of communication system e.g. Satellite dish, cable or other if they need to choose what to install in their homes.
- *Understanding that is just adequate for its purpose*: Individuals tend to be happy with a level of understanding that serves its purpose, without questioning its validity, this often leading to holding misconceptions about scientific issues.
- *Knowledge that is considered at a same level as other types of knowledge:* Social, and psychological aspects are on the same level as scientific knowledge.

- *Scientific knowledge that is considered alongside its social and institutional connections:* Citizens value scientific knowledge according to its source. So knowledge being issued by particular institutions will be held to be more valid than that of other institutions that do not hold as high a status.
- *Attitudes to considering risks associated with scientific and technological issues:* Citizens tend to carry out risk assessments on the basis of other aspects such as social, psychological and contextual factors than just on scientific basis.
- *Informed citizens make more discriminating judgments about science and technology related issues:* The more informed citizens are about scientific issues, the more they are able to understand the consequences and make better judgment. However, this does not automatically mean that they would necessarily make more rational decisions.

3. CURRICULAR IMPLICATIONS AND PEDAGOGY

It is on these aspects that an argument is put forward for the need to include the social aspect of science as part of students' science education to ensure better citizens in the future. The social aspect of science needs to become part and parcel of students' science education rather than just an added on activity every now and again. If one wants to have citizens that possess the necessary basic scientific knowledge; the skills needed to evaluate, analyse and be critical of the scientific knowledge presented; and to have attitudes towards science and sustainable development (moral, social, economic and ethical) in order to be able to make informed and independent choices with respect to scientifically related issues, it cannot be left to chance. Science educators have to design science curricula that incorporate social issues as an integral part of teaching schemes. This brings with it new demands and challenges to science education that would make it 'more value laden than content laden' (Gatt, in press).

Having put forward the argument for including the social, moral and ethical aspect of science, the question that automatically stems is – How do we teach it? One definitely cannot use the transmission view (Sutton, 1992). In such an approach, the learner is considered passive, simply receiving information that is stored without necessarily understanding the implications to everyday life

and society. If one wants students to develop skills, attitudes and values, teaching needs to be more student-centred rather than teacher-centred as in the case of the transmission view. It is essential that the learner is an active participant in the learning process. This puts forward an argument in favour of adopting the constructivist approach to teaching.

What is constructivism and what are its implications to teaching. A lot has been written about it and many have proposed different types of constructivist approaches. Basic to the theory of constructivism advocated by these numerous educators and researchers is the belief of the necessity for every human being to put together thoughts, interpretations and explanations which are personal to him or herself in making sense of his/her experiences and situations. How do students make sense of experiences? Windschitl & Andre (1998) argue that students construct their knowledge from individual and/or interpersonal experience and from reasoning about these experiences' (p.147).The learning process involves an interaction between the learner and the material to be learnt. Duit and Glynn (1996) 'view constructive learning of science as a dynamic process of building, organising, and elaborating knowledge of the natural world' (p.3). Constructivist learning is always an interpretative process involving individual's constructions of meaning relating to specific occurrences and phenomena. These constructions are built through their relation to prior knowledge (Watts, 1994, p.32).

The origins of constructivism can be traced back to Giambattista Vico in 1710 who argued that one knows a thing only when one can explain it. Since constructivism has become a popular theory of learning in science education, various 'strains' of constructivism have been put forward in literature. These range from cognitive constructivism (Cobb, 1994), sociocultural constructivism (Cobb, 1994), piagetian constructivism (Stofflet & Stoddard, 1994) also referred to as psychological constructivism by Matthews (1994), critical constructivism (Watts & Jofili, 1998), contextual constructivism (Cobern, 1993), trivial constructivism (Von Glasersfeld, 1993), social constructivism (Von Glasersfeld, 1993) or sociological constructivism (Matthews, 1994), pragmatic constructivism (Bettencourt, 1993) to radical constructivism (Von Glasersfeld, 1995) among others. Constructivism has also been attributed to form part of a number of academics' theories, ranging from Jean Piaget (Bliss, 1993) and his theory of cognitive development, George

Kelly (Bannister and Fransella, 1986) and his personal construct theory, Vygotsky (1978) and the idea of scaffolding to radical constructivism by Ernst Von Glasersfeld (1993).

The constructivist philosophy, whatever the approach, holds that individuals construct for themselves a unique picture of the world, and that in constructing this picture they must understand the concepts which, in the case of science, the scientific community accepts as being true. The question for science teachers thus becomes how to provide for individual's private knowledge construction but at the same time ensure that this private knowledge relates to the publicly accepted knowledge constructed by scientists. Science teachers must become flexible in their planning to enable them to change direction in response to students needs (Hand & Vance, 1995). Hence the argument is being put forward in favour of adopting a constructivist approach when teaching science for citizenship.

The debate regards constructivist teaching concerns the extent to which it is possible for any teacher to intervene in the thinking of a learner. This highlights the purpose and value of an intervention and how this can be achieved, and how effective it may be (Watts & Jofili, 1994). Learners organise and manage experiences so that their actions maximise desirable results and minimise undesirable ones. A constructivist teacher works at the interface between learner and the curriculum, to merge agendas and bring the two together in a way that is meaningful for the learner without diminishing the curriculum. It must be noted, however, that construction does not give students the licence to claim that their meaning is as good as that of the scientist (Fensham, Gunstone & White, 1994). It is important to keep in mind that some meanings are better than others, especially those constructed and agreed on by the community of scientists. Likewise, one can use the same argument in the case of looking at the implications of scientific research to society and the environment.

Constructivism has been widely adopted when developing teaching schemes aiming at improving students' understanding in science and specifically in targeting students' wrong ideas, known as alternative frameworks. Examples of the main approaches included conceptual change (Posner *et* al, 1982; Strike & Posner, 1985), Driver and Oldham's (1986) constructivist approach adopted in

the Children Learning in Science (CLISP) project, concept mapping (Hammer *et al.*, 1998) and mental models, (Gilbert, 1998). Common features which emerge are the use of cognitive conflict, metacognition and the application of scaffolding in promoting students' active participation in learning.

Duit and Glynn (1996) suggest that a constructivist model of science instruction demands that teachers need to encourage students to think metacognitively (thinking about their own thinking) by activating students' existing mental models. This can be achieved by supporting the process of constructing mental models, helping students to transform conceptual models into physical ones and to think out loud. Teachers need to encourage students to represent a problem in a variety of ways and have students assume the role of teachers, employ reading, writing, discussion and debate. They also need to begin lessons with simple concepts and problems to foster motivation and question students 'who, what, when and where', encouraging students to pose their own science problems. These are approaches that fit in well when considering social implications. This argument is discussed in more detail further on.

These aspects emphasise the need for learning to be stimulating. One can achieve this through the use of challenge or cognitive conflict, reflection or what is known as metacognition, and the ability to build patterns (Adey, 1997). It is important to provide children with opportunities where they can work out their ideas in their own language (Baxter, 1998) and to look at the implications of such issues.

The whole learning process is based on a number of basic implications about constructivist learning. Driver and Oldham (1986) list these assumptions to include:

- Learning outcomes depend on both the learning environment and the learner's prior knowledge. Teachers cannot assume that students do not possess any ideas about concepts and issues before formal instruction. On the contrary, children do hold ideas and these interfere with the learning that takes place;
- Learning involves the construction of meaning. Students need to make sense of what they are doing in order to learn;

- Construction of meaning is a continuous process. Learning takes place all the time and teachers should allow time for learning and construction of knowledge to take place;
- Meanings, once constructed, are evaluated and can be accepted or rejected. Students evaluate experiences they encounter in terms of their previous experiences. From this they decide whether they accept this new knowledge or not; and
- There are patterns in the types of meanings students construct due to shared experiences and language used for communication.

Going back to the issue of teaching skills, attitudes and values and in considering the constructivist approach to teaching, one asks what would be the type of learning activities that teachers could adopt. What is central to any activity that targets the teaching of these aspects of science must be based on one particular central issue, that the students must have ownership of the activity and issue being considered. It is only through ownership that students can empathise and understand the various implications of scientific issues. So what types of activities can teachers organise to highlight the social aspect of science? A holistic approach needs to be taken that allows students to research, learn, share opinions and consider ways in which they can take action. Here are some approaches that teachers can adopt.

- **Discussion:** A simple discussion of an issue where children give their views about the implications of science. This is however, at a lower level of active engagement. However simple this approach, teachers need to learn how to ask questions that provoke discussion. They also need to be able to create an atmosphere where students feel that their opinions are valued and provide a valid contribution to the discussion. Teachers have to be careful to remain impartial, act as chairs and steer discussion on the issue without taking over or imposing their positions about the issue.

- **Poster production:** Children can be asked to draw posters to send messages about issues that they have discussed. Posters are usually designed to send out messages to specific groups. Teachers can help students conceive the implications of science by asking them to draw up posters about an issue but which target a different group, that is, different audiences. When one changes the audience for which a piece of work is

designed, it promotes an understanding of different perspectives of an issue to different interest groups related to the issue being considered.

- **Language activities:** Most of the activities in schools involve practice in written work. Teachers can utilise these sessions to consider a particular social issue and ask students to write about it, or make an oral presentation about it. Each time it is important to specify the audience for whom the letter/report/presentation is. This makes the children pay attention to what they have to say and in what way, leading to active reading, writing – knowledge construction. In fostering understanding different perspectives, students can be asked to take up various roles, such as the government's position, the activists' view, the local authority etc. It is a way of helping students realise how the same issue impinges on different interest groups in different ways, how different groups have different agendas and how these influence the way people interpret and take standpoints with respect to scientific issues.

- **Research Projects:** The teacher can introduce a social issue that is of current concern. A newspaper cutting, news report or some other form of contribution in the media can be used to spark off the discussion. However, in this case, students will be asked to look up some scientific information about the issue. It is important to try and elicit differing ideas and opinions so that cognitive conflict would be present. Cognitive conflict is one way of promoting meaningful learning. Getting students to disagree will motivate them to look up information and to formulate arguments in favour of their belief. It is a strong learning tool that makes learning a lasting experience.

- **Role playing:** Role playing is one way of getting students to understand how people in different positions view things differently due to having different agendas. An issue can be tackled, for example the decision to allow research in a particular type of cloning and students are asked to represent different groups, for example, the government, the Health Minister, the research institute proposing the study, the anti-abortion group, the normal citizens etc. Each group would have to look at the issue from the particular group's point of view and come up with a standpoint, an argument in favour or against. This would require that they carry out

background scientific research, that they understand the implications of allowing the particular research to take place.

There are a number of common features on which all of these types of activities are based. In fact some of such examples have been already written about by Lock and Ratcliffe (1998). The one single significant common factor is that children are actively involved in the learning process. When one deals with values and attitudes it is difficult to transfer these by simply 'telling'. One needs to place children in a position where they can understand the implications and how different groups have different agendas that may not include the welfare of the population or the world. This is achieved through getting students to disagree by holding different points of view, thus promoting cognitive conflict. If children disagree about an issue, they will then want to know about it in order to make an argument in favour of their standpoint and against that of the other or to show whether an assertion made is correct or not. The issue becomes a personal thing and this is very effective in promoting learning.

All the activities listed involve some form of use of language. This being spoken during discussion, written in producing reports, posters, reading material or listening to another groups' perspective, language forms an integral part of the learning process. In the same way as one understands a problem in the process of formulating a question about it, so will language, similarly, facilitate the understanding of the intricate issues involved when one considers the environmental and ethical issues related to science and scientific research. It is thus essential that examples chosen should be relevant and related to the students' experiences.

Finally, one must also consider the value of metacognition. Teachers too often assume that students are capable to reflect on the things that they come across at school and to see the intention behind such educational activities. However, this is often not the case. Metacognition is essential to learning as it provides learners with conscious control over their own learning processes. Teachers, therefore, need to find time to ask students to reflect on what they have been doing, why they have been doing it and the value of it. They should encourage students to trace how their level of knowledge, opinion, and attitude has changed as a result of the learning activity. Students do not go through

such a process unconsciously and teachers need to promote it until it becomes an internalised process.

Obviously, the methods suggested are not exclusive. Whatever the type of activity, what is most important is to get the children involved. However, there is a changing view of what doing science in schools is to involve. There is a strong argument in favour of introducing the social aspect of science as an integral part of the science curriculum. There are also implications for changes in the way that science is to be taught. Many times, science involves the understanding of concepts that are detached from their implications to everyday life and society. Laboratory work is used mainly for the illustration and understanding of these concepts and to train students in the process of doing science. The new approach to science being advocated is that of a more holistic view of science where case studies about relevant current scientific issues are considered such that students have the opportunity to realise the implications of science on everyday life, society and the environment. This requires that teachers change their view of the meaning of doing science and to adopt different teaching methodologies than those that have been used so far.

4. IMPLICATIONS TO PRACTICE

These new approaches require different teaching capabilities than those for which teachers have been trained during their pre-service training. This demands that teachers be provided with training to equip them with the new sills required to deliver a different curriculum. Teachers need support at different levels: technical; planning; pedagogical and management level. At the technical level, teachers need to become familiar with ICT and have good working knowledge of basic programmes. A good percentage of primary teachers in Malta are over 40 years old and experience technophobia. Likewise, one may also find secondary level teachers who are not that conversant with new technologies. Proficiency in ICT is crucial as students would be required to carry out most of their research on the internet. In today's knowledge society, it is impossible for teachers to know all the content knowledge that is required for teaching, particularly if one is considering new technological advancements that are being added every day. Teachers therefore need to possess the technical

capability to use ICT in their teaching so that they can help their students in searching and finding information about issues being discussed.

Activities targeting social issues in science are different from the traditional teaching approach. Teachers thus require new competencies to be able to prepare such activities. Since there is a tendency for these activities to be open-ended, and often there tends to be more than one possible solution, teachers may feel insecure as to how to plan and prepare their lessons. One way of overcoming this insecurity is through good planning and preparation. Rather than preparing the one correct possible method leading to one solution, teachers need to learn how to plan in terms of resources that enable students to look up relevant information. Teaches therefore need to know how to deal with the possibility of different outcomes and how to plan processes rather than products. Such skills are not easily acquired as they always bring with them a degree of uncertainty as how lessons would proceed. There therefore needs to be in-service training for teachers so that they realise the different demands in planning and to develop the necessary competencies for carrying them.

Good planning is only possible if teachers have good pedagogical background knowledge. Recent years has seen great research providing contributions and insight about the teaching and learning process, and particularly with respect to how this applies to the learning of science. New modern approaches, mainly within a constructivist framework are being advocated by many researchers. Teaching about the social aspect of science falls within these new trends. Consequently teachers are required to possess new pedagogical skills that they may not possess. It is therefore necessary to help teachers develop, either through in-service training or in-school support, these new and up to date skills such that they will be capable to respond to these new demands in the teaching of science. In addition, there also needs to be a cultural change as to how teachers view learning and how teaching in schools is to be. This cultural change is crucial as it is only when teachers are convinced of the efficacy of the approaches they adopt that they manage to deliver the curriculum effectively.

These new teaching approaches have produced a shift towards student-centred activities. Such activities demand that teachers have different management skills than those usually required in the traditional teacher-centred

approach. Having students working on projects where different groups of pupils may be at different stages in their work and carrying out a variety of activities running concurrently requires different management ability than the traditionally teacher-led lesson did. It would not be of any use if there is good pedagogical planning and delivery but bad management. Teachers can only provide quality experiences if they possess all of these capabilities combined. The role of the teacher has evolved in a much more complex issue than that conceived a few years ago. As the world becomes more digitized, complex and intertwined, the same can be said to what should be taking place in schools. It is ultimately the schools' responsibility to prepare students for a productive and independent life in the world and they consequently have to mirror the present expectations and demands rather than yesterday's reality. This means that teachers carry a great responsibility in ensuring that tomorrow's citizens would be capable of being truly active citizens that ensure a better future for humankind.

5. CONCLUSION

There is no doubt that we are living in a fast changing world. The science education provided to students should mirror this. Rather than aiming to cover all the content generated, which would be an impossible feat, the capability of independent learning and understanding of scientific issues and their implications to everyday life become more important. This calls for a radical change in the way that we view science education. It is essential that this change is brought about, and quick, as otherwise we would end up with a future where citizens would not be capable of handling the scientific capabilities that we ourselves have developed. Such great power in ignorant hands would be dangerous to the future of our world. It is thus essential to act now if we want future generations to enjoy a better quality of life than we have today.

This paper is based on work done on citizenship as part of the RIAC (Regional Identity and Active citizenship) Comenius 3 network (website http://www.riac.tsn.at)

REFERENCES

Adey, P., S., (1997). It all Depends on Context, Doesn't it? Searching for General Educable Dragons, *Studies in Science Education,* Vol. 29, 45-92.

Bannister D., & Fransella, F., (1986). *Inquiring Man: The Psychology of Personal Constructs*, 3rd Ed. London & New York: Routledge.

Baxter, M., (1998). Planning for Teaching and Learning, in Ratcliffe M., (ed.), *ASE Guide to Secondary Science Education,* Cheltenham: Stanley Thornes.

Bettencourt, A. (1993). The Construction of Knowledge: A Radical Constructivist view, in Tobin, K., (ed.) *The Practice of Constructivism in Science Education,* New Jersey: Lawrence Erlbaum Associates Publishers.

Bliss, J., (1993). The Relevance of Piaget to Research into Children's Conceptions, in Black, P., & Lucas, A.M., (eds.), *Children's Informal Ideas in Science,* London: Routledge.

Cobb, P., (1994). Where is the Mind? Constructivist and Sociocultural Perspectives on Mathematical Development, *Educational Researcher,* Vol. 20, No. 7, 13-20.

Cobern, W., (1993). Contextual Constructivism: The Impact of Culture on the Learning and Teaching in Science, in Tobin, K., (ed.), *The Practice of Constructivism in Science Education,* New Jersey: Lawrence Erlbaum Associates Publishers.

Driver R., Leach J., Millar, R. & Scott P., (1996). *Young People's Images of Science,* Milton Keynes: Open University Press.

Driver, R., & Oldham, V., (1986). A Constructivist Approach to Curriculum Development in Science, *Studies in Science Education,* Vol. 13, 105-122.

Duit, R., & Glynn, S., (1996). Mental Modelling, in Welford G, Osborne J. & Scott, P. (eds.), *Research in Science Education in Europe,* London : The Falmer Press.

Durant J. Evans G., Thomas G., (1989). The Public Understanding of Science, *Nature,* Vol. 340, 11-14.

Fensham, P., Gunstone, R., & White R., (1994). *The Content of Science: A Constructivist Approach to its Teaching and Learning,* London: The Falmer Press.

Gatt S. (in press), Bringing the Social Aspect in Primary Science, *CASTME International Journal.*

Hand, B., & Vance K., (1995). Implementation of Constructivist Approaches within the Science Classroom, *Australian Science Teachers Journal,* Vol. 4, No. 4, 15-28.

Isin E., & Wood P. (1999). *Citizenship and Identity***,** London: SAGE Publications.

Jenkins E. (1997). Scientific and Technological literacy for citizenship: what can we learn from research and other evidence, in Slojberg S. and Kallerud E., (eds.) *Science Technology and Citizenship,* Oslo: NIFU.

Matthews, M. (1994). *Science Teaching: The role of History and Philosophy of Science,* New York: Routledge.

Miller, (1983). Scientific Literacy: a conceptual and empirical review, *Daedalus*, Vol. 112, No. 2, 29-48.

Ratcliffe M., (1998). The Purposes of Science Education, in Sherrington R. *ASE Guide to Primary Science Education,* Stanley Thornes.

Schmitt-Enger, (2004). European Citizenship: Conceptual foundations and practical implications, Paper presented at the *RIAC Thematic conference, Citizenship and Youth participation: the social, political and environmental aspects of citizenship*, Malta, 17-21st November 2004.

Stofflet, R., & Stoddart, T. (1994). The Ability to Understand and use Conceptual Change Pedagogies as a Function of Prior Content Learning Experience, *Journal of Research in Science Teaching,* Vol. 31, No. 1, 31-51.

Sutton, C. (1992). *Words, Science and Learning,* Milton Keynes: Open University Press.

Von Glaserfeld, E. (1995). *Radical Constructivism: A way of Knowing and Learning,* London: The Falmer Press.

Von Glaserfeld, V. (1993). Questions and Answers about Radical Constructivism, in Tobin, K. (ed.) (1993). *The Practice of Constructivism in Science Education,* New Jersey : Lawrence Erlbaum Associates Publishers.

Vygotsky, L.S. (1978). *Mind in Society : The Development of Higher Psychological Processes,* Cambridge, Massachusetts: Harvard University Press

Watts, D.M., & Jofili, J. (1998). Towards Critical Constructivist Teaching, *International Journal of Science Education,* Vol. 20, No.2, 173-185.

Watts, D.M. (1994). Constructivism, Re-Constructivism & Task- oriented Problem-Solving, in Fensham P., Gunstone, R. & White, R., (eds.) *The Content of Science: A Constructivist Approach to Teaching and Learning,* London: The Falmer Press

Windschitl, M., & Andre, T. (1998). Using Computer Simulations to Enhance Conceptual Change: The Roles of Constructivist Instruction & Student Epistemological Beliefs, *Journal of Research in Science Teaching,* Vol. 35, No. 2, 145-160.

Wynne B. (1990). The Blind and the Blissful, *The Guardian,* 13 April, 28.

The Cyprus Journal of Sciences, Vol. 3, 2005/19-31

E-PSYCHOLOGY: BETWEEN CHARITY AND BUSINESS

MALINA JORDANOVA*

ABSTRACT

The convergence of electronic equipment and telecommunication facilities for exchange of audio, video, and/or text therapeutic communications has been termed e-psychology. It is used when face-to-face contact with licensed psychologist is impossible. This paper presents e-psychology consultations and their pros and cons as foreseen in an ongoing e-health project, aiming to employ remote networking technology to enable direct communication between experts and patients for virtual consultations, supervisions, psychological evaluations and continuous monitoring. Thus the projects will offer high quality psychological service via Internet.

Key words: e-psychology, virtual consultations, e-health, rural area

1. WHAT IS E-PSYCHOLOGY

During the last decade, Internet is used to provide psychological services to people all over the world. The utilization of information and communication technologies for online counselling and therapy is one of the most interesting and at the same time rather controversial areas emerging in contemporary psychological. The idea is not a new one. Discussions about utilization of the net for the needs of psychology began almost 35 years ago with the start of Internet's prototype, the project ARPANET. The later started operating in late 1969 and ended in 1989.

Often termed as e-, tele-, virtual or cyber-psychology, this new psychological area relies on convergence of available electronic equipment and telecommunication facilities for exchange of audio, video, and/or text for therapeutic communications. In general, e-psychology consists of short interventions and is used when face-to-face contact with licensed psychologist

* Research Institute of Psychology, Bulgarian Academy of Sciences, Sofia, Bulgaria

is impossible due to lack of transport, long distance, extreme situations, etc. Virtual psychological consultations are alternative, especially for people who cannot afford private consulting, or for those who are afraid to speak about their difficulties face to face to a counselor, or for shy people who want quick answers (Garcia et al. 2004). To put it briefly, thanks to the development of new information and communication technologies this service is available and it is an option for a rapid psychological counseling while at the same time expands the group of potential users of psychological help. However, e-psychology has its risks, especially for the psychologist, who lacks the possibility to check user background, or use non-verbal language necessary in any counseling and interviewing process.

Most often e-psychology is realized as exchanges of e-mails, chat or chat groups, videoconferences. As a whole it is very effective and patients highly evaluate Internet contacts with psychologists. Surveys revealed that users' satisfaction varies from 68% (Ainsworth, 2004 and Wildermuth, 2004) up to 88% (Lahad, 2004). That is why e-psychology musters up strength. Its applications have the potential to advance the fields of psychology in a multitude of ways. A few of possible e-psychology applications for patient care are assessment, psychotherapy, crisis intervention, patient education, etc. It is also applicable for the needs of psychology community. Teaching activities, vocational assessments and case management are few examples. However, e-psychology is so new that both technology and strategy are still under considerable development.

Another aspect of e-psychology and especially of Internet psychological consultations is that in many cases they are free of charge. Or at least, lots of web pages offering e-psychological services start as free consultations sites. Although this is very attractive it causes problems in the psychological community as it is difficult to define the exact boundary between psychological consultations offered as charity and business in psychological counselling. For users it is also often difficult to understand the difference, in particular when is necessary to switch between free services and paid treatments.

The purpose of this paper is to present e-psychology and its pros and cons as foreseen in the ongoing in Bulgarian telemedicine pilot project. It will

discuss only one aspect of e-psychology – virtual psychological consultations and how we are planning to manage between charity and business.

2. THE PROJECT IN BRIEF

The project is co-funded by Bulgaria and International Telecommunication Union (ITU), started on October 1st, 2003 and will continue for two years. It was developed in conjunction with the Valetta Action Plan (http://www.itu.int/ITU-D/univ_access/program3.html) that sought to promote universal access to basic telecommunications, broadcasting and Internet as tools of development in rural and remote areas. The project focuses it efforts towards introducing e-health in rural and semi-mountainous region in Bulgaria. It has to develop, test and evaluate the effectiveness of a local, packet-based wireless access infrastructure relying mainly on 2.4 GHz frequency band and optic connections in rural area, building and equipping public tele-centres in 10 villages and connecting them in a network. In addition, the network is connected to local Emergency medical centre and specialized tele-server at Bulgarian Academy of Science. Thus the project has to provide a platform for the wide introduction of multimedia services such as telemedicine (especially telecardiology), telepsychology, teleeducation, etc. Project partners are: from Switzerland ITU and from Bulgaria - Ministry of Transport and Communication, national Telecommunication Company, the Association of Telecenters, Septemvri Community (the region where the project takes place) and Solar-Terrestrial Influences Laboratory at Bulgarian Academy of Sciences (STIL-BAS). STIL-BAS is responsible for the e-health part of the project, including e-psychology.

Project's target region is a small semi-mountainous region, Septemvri community. The reason to direct attention to a rural area is that 31.6% of Bulgarian population lives in remote villages. If the percent of citizens from small towns is added, more that half of the Bulgarians live in rural areas. People in rural areas are in unfavourable conditions when access to IP-based technologies is considered.

So, one of the project's aims is to develop and offer a virtual high quality psychological service to people from remote areas that had no possibility to

consult a professional. Text, color images, short-segment video and audio clips will be transmitted during the course of the project. Thus the project employs state-of-the-art remote networking technology to enable experts to communicate directly with patients and to perform remote consultations, supervision, psychological evaluations and continuous monitoring as well as to advise rural psychologists and health workers.

3. WHY E-PSYCHOLOGY WAS INCLUDED IN THE PROJECT?

FIGURE 1: LOCAL VIRTUAL PSYCHOLOGICAL SITES OFFERING 0N- AND OFF-LINE CONSULTATIONS

Photo collage created by the author

The main reasons are:

- The means to offer e-psychological consultations are available. Experience of other countries revealed the importance of e-psychology and its effectiveness. But foreign expertise is not applicable if there are not accurate conditions to introduce it and if this expertise is not adjusted to local characteristics and requirements.

- In Bulgaria there is a demand of such service. Although computers and Internet are not available in every household, about 1% of Internet visitors are looking for psychological information and support. What are users looking for? The answer is simple. Many people know how they should live healthier (food, weight, exercise, etc.) but are not able to adjust their life to this knowledge. Internet users are very much looking for such information. In addition, they are looking for psycho logical advice and counseling in lots of areas covering life-style problems, loneliness, melancholy, jealousy, marital problems, alcohol and drug dependence, bulimia, etc. All of these may be just a part of everyday life, or may be serious mental illnesses, or anything in-between. Even less serious problems are often a cause of misery and lack of capacity for productive work and healthier life. Several web sites already exist offering exclusively or as part of their services virtual psychological consultations (Fig. 1). Some are free and some require a small fee. The users contact these sites usually from home. In the project's target region home computers and Internet access from home are rear. Development of local public free of charge tele-centres, as realized in this project, is a solution offering a bigger proportion of population access to virtual psychology consultations.

- In addition, traditionally, psychological help has been treated as the Cinderella of health services despite its importance. World Health Organization estimates that nowadays almost 1 500 million people suffer from psychological problems and need help. Despite this fact, psychological consulting, with some exceptions, is not covered by insurance funds. E-psychology offers relatively cheap solution which may satisfy patients and will not put enormous burden on health care budget.

4. REALIZATION

Enthusiastic licensed psychologists are involved in virtual psychological consultations, including representatives of the Institute of Psychology at the Bulgarian Academy of Sciences (IP-BAS). This is the most appropriate decision as IP-BAS is the largest national center for fundamental psychological

research and transfer of scientific achievements in different branches of psychology and technology. Thus the project employs state-of-the-art remote networking technology to enable experts from the IP-BAS to communicate directly with patients and to perform remote counselling and supervision.

FIGURE 2: WORKING PLACE FOR VIRTUAL PSYCHOLOGICAL CONSULTATIONS

Potential patients/ users have to visit local telecenters where specialized, hidden from view and sound proof places for psychological consultations are equipped. Thus if and when necessary, users rely on technical advice and on the help of tele-centre staff. The technical staff will not attend tele-sessions. Direct connection is organized between local tele-centres and a server at STIL-BAS. The latter is used as an actual working place for virtual psychological consultations (Fig. 2). In order to make e-psychological contact as easier as possible, 3 models of contacts are foreseen:

- Exchange of text messages, i.e. e-mails;
- Internet telephony and
- Video connection.

Both on-line and off-line sessions are planned. Off-line sessions rely entirely on text messages. Visual contact will be used only in case of necessity and after preliminary agreement between the user and the psychologist. It is

essential to be underlined that the project does not focus on treatment of severe mental conditions. It is not oriented towards the serious illnesses, which may require hospitalization. E-psychology, as foreseen in the project, is targeted at those many people, from all age groups, who are suffering in silence, who do not seek a doctor or psychiatrist but who can be aided in achieving a better and more productive life by psychological advice.

5. OUR PREFERENCES

In a word, we prefer and put the stress on text-messages as main communication source of e-psychological counseling. Reasons to prefer e-mail contacts are:

E-mails are easy to use, familiar to many potential patients and very similar to writing letters, minus the annoyances of addressing envelopes, licking stamps, and looking for a mail box. In addition, e-mails provide a non-visual and non-auditory, private and reliable way of communication and create a psychological space in which pairs of people interact.

E-mails create a text talk as John Suler (2004) brilliantly explains. For those who love to write, e-mail is heaven. Lots of people feel that they can express themselves better in writing. A skillful writer is able to communicate considerable depth and subtlety in the deceptively simple written words. Writing may involve different mental mechanisms than in-person talk. Written dialogues reflect a distinct cognitive style that enables some people to be more expressive, subtle, organized, or creative in the way they communicate. Written texts often reveal personal characteristic, which is of significant help during virtual consultations. For example, compulsive people may construct highly organized, intellectualized messages with little emotional revelation. Histrionics may show less concern about organization and much more for the emotions they express. Narcissists may write extremely long, rambling blocks of paragraphs, while schizoids may produce very short but penetrating messages.

E-mails may be anonymous. If users want, they may use a pseudonym, not real names. The only requirement is to keep the same pseudonym during the

entire duration of e-psychological contacts. In addition, e-mail contains some general addresses, which also enhances the feeling of anonymity and protection. Average Internet users are not aware how to track down the origin and identity of the message. If someone is determined to remain hidden, he / she may do so. This potential for anonymity in e-mailing and the lack of face-to-face cues disinhibits some people, which is very important in small patriarchal communities as those engaged in the project. Thus people feel free to say things they wouldn't ordinarily say, encourages them to be more open, honest, and affectionate.

E-mail contacts usually are off-line and do not occur in real time. They do not create simultaneous conversations. This is essential for users / patients as it gives to them time to think, evaluate and compose their messages in the most appropriate way. The same applies for licensed psychologists, who are not pressed to respond on-the-spot and if necessary may take advantage of this and dedicate more time on considering every particular case. In addition, the asynchronous character of e-mail exchange gives chance to adjust the speed of virtual counseling according to the needs of the users. Interactive time can be shortened or stretched, as needed.

Last but not least, e-mails exchange enables us to record the interactions by saving the typed-text messages.

Of course, usage of e-mails has negative sites too:

Some people may not be attracted to e-mails because they involve typing. Everyone knows how to talk but not everyone feels comfortable in typing. We expect that some potential users may not be able to express themselves through e-mail. Definitely, the typing/writing barrier will filter some users.

E-mail anonymity is not fundamentally a "good" thing. It may turn out to be "bad" as well. It cuts both ways.

Spam is another negative aspect of e-mailing. All e-mail users are subjected to junk mails aimed to sell something. This may be a serious problem, as people subjectively experience e-mail as a personal space. Receiving spam may beat back some users.

Foreseen solution is available Internet telephony and pre-scheduled sessions with licensed psychologist for those who are not willing or ready to rely on e-mail contacts.

6. PROBLEMS

Project partners are realistic in their expectations and prepared to face significant problems during the realization of e-psychology application. Some of these problems are already a reality, others are still latent. Few of the problems that we are overcoming are:

1. Negative attitude or at least suspicion towards e-psychology applications and especially to distant consultations as compared to face-to-face service. This is a problem we already have and are trying to beat down. Both psychologists and potential users are suspicions. This attitude has changed very slowly and with lots of efforts. Examples of international surveys as well as of prosperous local websites are discussed. Potential patients / users more easily change their mind. They are ready to switch from total rejection to the position "Let's try and see the result". Once partially satisfied they are ready to keep on going. Resistance of licensed psychologists is a serious difficulty, especially when older psychologists are concerned. They have enormous experience and attracting them to the idea of e-counseling is of benefit for the users. Opposition to e-consultations is due to:

    a) Fears for career threats. They may not be real as not a single technology is expected to take the place of experienced professionals to man the battlements. But the worries are real and they can be a cause of serious resistance to change, which in turn make entertaining new ideas and implementing much-needed technologies difficult, if not impossible. Leadership is important in alleviating much of the stress.

    b) Fears of velocity of technology changes. Internet time is fast. The pace astonishes even people who work for and with Internet companies. Speed is of the essence in order to keep up with

technological changes as keeping inline with technology is vital to keep potential patients / users especially from younger age groups.

c) Fears of loosing profits. These are the main fears as for the moment adequate reimbursement policy does not exist. Health insurance funds do not cover virtual consultations. Or again, this is the problem to separate charity and business. But these fears are not well-founded either. It is recognized that traditional psychology consultations serve only fraction of the population who really need it. To many people Internet seems more private, and this perceived privacy helps them cross the barrier of stigma to seek help through e-counseling. Internet is providing a bridge across one of the barriers that keeps people from getting the help they need. Thus e-psychology expands the group of potential patients and reaches people that in most cases will never meet psychologist face-to-face. About 60% of virtual psychology patients consult licensed psychologist for the first time in their life. What is more, over 65% of e-psychology patients undertake the next step toward face-to-face consultations and treatment (Jordanova 2004). Thus, simple estimations revealed that even when virtual psychology consultations are free of charge, even when they are offered as charity, the result is an increase of paid face-to-face consultations. Put in other words, efforts dedicated to e-psychological charity at the end received reward. In the case of virtual psychology, charity enhances business.

2. The lack of technical experience of some users and licensed psychologists also is a problem. For the moment two are the ways to overcome this obstacle: (1) training courses for licensed psychologists to use and become familiar with Internet technology and (2) Technical support of users in local telecenters.

3. Another serious problem is uneven assess to Internet. The profile of Internet users in the country reveals that (a) Internet usage in small villages is times smaller than in the capital or big cities; (b) There is a significant age and sex differences in Internet usage too – with the increase of mean age the percent of Internet users drops and reaches 3.1% in the age group >50 yrs. In addition, men access Internet almost times more than women (ABC Design & Communication 2003 a & b;

Petrova 2000). This problem is not easy to overcome. Partial solution is the development of free community telecenters, which is a strategic goal of the project. Advertisements and active involvement of local administrative and medical authorities also help. In some cases general practitioners are those who have to push people to use virtual consultations.

4. Human face and body language are rich in meaning and emotions. The biggest disadvantage of virtual communication, especially when it consists of e-mails exchange, is the lack of nonverbal communication channels. These account both for psychologists and for patients. When one cannot see other people's faces or hear them speak he is loosing all subtle voice and body language cues. Thus assessing the nuances of communicating is very difficult. The lack of face-to-face cues may result in ambiguity. This enhances the tendency to project someone's expectations, wishes, anxieties and fears into what the other person wrote, unto the somewhat shadowy figure sitting at the other end of the Internet. Psychotherapists call this a "transference reaction" or "projection". It is unconscious and could lead to misunderstandings as people do not realize how it is steering their behavior. As usual, the coin has two sites, i.e. the position of some psychologists is just the opposite. They claim that the exchanges of text messages carry us "past the distracting superficial aspects of a person's existence and connects us more directly to their mind and personality". For them seeing is equal to believing. They are advocates of video channels. In an attempt to minimize this problem, the project gives a possibility to add video connection if and when necessary. This will be done only after preliminary agreement of users. Under discussion is a possibility to "project" a photo of psychologist leading virtual consultations. Hopefully this has to decrease the transference reactions.

5. Ensuring technical security and confidentiality of virtual consultations may also be a problem as despite numerous technical solutions, the possibility for un-authorized access to e-psychology information cannot be totally neglected.

6. Highly educated and informed users, especially the "21st century health care consumers" also known as the 3 "C's" consumers (cash, college and computers) may cause problems (Mittman & Cain, 2001). The attitude toward them has to be slightly different as their expectations are for free choice and high level of service but at the same time they lack "healthcare culture", expect to achieve results with almost magic speed, which is not realistic in the field of psychology, and easily give up.

Despite the above mentioned problems, partners believe that expected outcomes will compensate all difficulties. Predictable results at project's end are: improved quality of psychological support due to easily, cheap, fast, private, at any time and from anywhere contact between licensed psychologists and users; avoidance of inconvenience of traveling; cost and time saving and increased psychological comfort. In addition, we hope to find the precise border line between charity and business. The initial idea is to offer free service till the end of the project. After a two years period the project has to become self-supported. This will be done as keeping many services free of charge but at the same time introducing some pre-paid services, too. An idea that will be checked is to ask small fee when e-consultations exceed a given pre-defined number. Thus both users and psychologists will be protected – those users who need short term treatment will continue to receive free advices, while at the same time payment will be ensured for professionals.

7. CONCLUSION

Newly developed IT solutions and especially Internet with its low-cost, ease of use, distance insensitivity and increasing functionality, created many opportunities in the field of psychology for expanding the way that knowledge and services have traditionally been disseminated. In the field of psychology, people have to harness these resources for ensuring psychological care and professional growth. On the other hand, the utilization of these resources can have both positive and negative effects upon psychology and potential users. In order to accentuate the benefit of this technology and minimize the pitfalls a lot has to be done. Based on the achieved expertise, guidelines should be developed to help structure the manner in which WWW have to be used for e-counseling. Through this project, exploiting new technology, we hope to

illuminate the potential for virtual psychological counseling, and to share our evolving understanding of what is truly possible, despite the prevalent myths, which shape our thinking about e-psychology.

REFERENCES

ABC Design & Communication (2003 a) On-line statistics, New Media Ezine, 14.04.2003, http://www.abcbg.com/cgi-bin/ezine.pl?b&00125 – Last visit 05.11.2004.

ABC Design & Communication (2003 b). Bulgarian Internet users, New Media Ezine, 14.04.2003, – Last visit 05.11.2004. http://www.abcbg.com/cgi-bin/ezine.pl?b&00249

Ainsworth M. (2004). E-Therapy: History and Survey, – last visit November 5th, 2004. http://www.metanoia.org/imhs/history.htm#today

Garcia, V., Ahumada L., Hinkelman J., Munoz R. and Queszada J., (2004). Psychology over the Internet: On-Line Experiences, *Cyberpsychology & Behavior*, Vol. 7, No. 1, 29-33.

Jordanova M. (2004). *Tele-psychology: Fiction or Reality for Remote villages*, Proceedings of Second National Psychological Conference, October 29-30 (in press).

Lahad M. (2004). Tele-psychology - Last visit November 5th, 2004. http://icspc.telhai.ac.il/projects/present/Tele_Psychology.htm

Mittman, R. and Cain, M. (2001). The future of the Internet in health care. In: Rice R. E., Katz J. E. (Eds.). *The Internet and health communication*, Thousand Oaks, CA: Sage, 47-73.

Suler J. (2004). The basic psychological features of e-mail communication - Last visited November 5th, 2004. http://www.selfhelpmagazine.com/about/staff/jsbio.html

Petrova M. (2000). Who is using Internet and for what purposes, Bulgarian Internet Survey – Last visit 05.11.2004. http://survey.vsnet.org/index.php?p=lib&pp=bguser

Wildermuth S. (2004). The Effects of Stigmatizing Discourse on the Quality of On-Line Relationships, *Cyberpsychology & Behavior*, Vol. 7, No. 1, 73-84.

The Cyprus Journal of Sciences, Vol. 3, 2005/33-45

THE EFFECT OF A HEALTH-RELATED AEROBIC DANCE PROGRAMME IN THE PHYSICAL ABILITIES OF BOYS AND GIRLS OF AGE 6 and 7 YEARS

G. MAVRIDIS, F. FILIPPOU, A. LAIOS, ST. ROKKA, ST. BOUSIOU[*], K. MAVRIDIS[**] and D. VARSAMI[***]

ABSTRACT

The purpose of the present study is a) to evaluate the level of health-related fitness in 6 to 7 year old children, before and after the application of an intervening aerobic dance program and b) to use the results of the study, for the creation of typical values, corresponding to the Greek reality. Thirty-nine children of the First Class of Primary School (M=6.6, SD=0.2) participated. Twenty pupils (N=20, 12 boys and 8 girls) composed the experimental group and the rest nineteen (N=19, 13 boys and 6 girls) the control group. The experimental group followed an aerobic dance program for twelve weeks, three times per week, with 45-minute sessions. The control group just followed the normal Physical Education program of the school. The health-related Prudential Fitnessgram test battery was used for the assessment of health related fitness. The results showed that an aerobic dance program enables us to improve all health-related abilities of children 6 to 7 years of age each at a different degree.

Key words: health-related fitness, aerobic dance, and first grade children

1. INTRODUCTION

The absence of physical activities from adults' everyday life is currently one of the most important reasons for the occurrence of cardiovascular disorders and early mortality (Paffenbarger et al, 1986). Although research has proven that physical activity can reduce the risk of cardiorespiratory incidents by one-half, 40% of adult Americans lead a sedentary life (Sallis & McKenzie,

[*] Professor, Department of Physical education and sport sciences, Democritus University of Thrace - Greece
[**] Elementary School Komotinis
[***] Gymnasio Makrohoriou

1991). The absence of kinetic activity contributes to the development of disorders of the cardiorespiratory system as much as obesity, high blood pressure, high cholesterol concentrations in blood and smoking (McIlroy et al, 1989).

The same condition, however, prevails in younger age groups. Research (Biering-Sorensen et al, 1994) has shown that the sedentary lifestyle led by children and adolescents contributes to the development of cardiorespiratory and other chronic disorders even during childhood. According to the National Children and Youth Fitness Study in the USA, 20% of children from 5 to 17 years old are considered obese, which is 50% higher than the equivalent percentage twenty years ago. Moreover, 40% of children from 5 to 8 years old develop at least one risk factor - obesity, hypertension, and high cholesterol levels - for cardiorespiratory diseases (Cotton & Goldstein, 1997).

Physical fitness can be distinguished into two categories: (a) skill-related fitness and (b) health-related fitness. Skill-related fitness includes those elements, which render an individual capable of performing athletic activities, and largely depends on one's genetic characteristics. It comprises such skills as precision, balance, spatial orientation, co-ordination, reaction time, strength and speed. Conversely, health-related fitness comprises cardio respiratory endurance, muscular strength and endurance, flexibility and body composition. These elements protect the human organism from disorders caused by the absence of kinetic activities in everyday life, which significantly contribute to the maintenance of one's good function and health (Corbin & Lindsey, 1984; Sheefeldt & Vogel, 1987). Providing these elements with exercise through regular physical activities can improve them or maintain them at their current levels (Pangrazi, 1997).

The modern lifestyle and the high percentages of obesity in children have led scientists to focus their interest on how to sustain or improve health-related physical abilities during childhood, the reason being that the development of risk factors during childhood is regarded as a prodrome of the development of risks in adulthood. This means that today's unhealthy child is tomorrow's potential patient. If however we manage to check the development of risk factors during childhood, we may be able to anticipate and prevent the

development of cardiorespiratory and other chronic disorders in adulthood (Ignico & Mahon, 1995).

Establishing and evaluating children's health-related physical-condition levels is the first step towards accomplishing the above aim. The next step pertains to sustaining or, even better, improving these levels. Exercise is one of the means, which considerably assists in the accomplishment of this aim, the reason being that it has a positive effect both on health-related physical abilities (Brodie & Birtwistle, 1990; Harsha, 2000) and on the enhancement of an individual's self-esteem (Eickhoff et al, 1983). Moreover, by improving his health-related physical condition, the adult reduces the likelihood of the development of disorders caused by the absence of physical activity and also improves the quality of his life.

The application of an aerobic dance intervention programme (Albert et al, 1990) on preschool children can improve their cardio respiratory endurance, agility and self-confidence. Aerobic dance programmes applied for periods of 8 to 10 (Werner & Durham, 1988; Ignico & Mahon, 1995) weeks and 1-2 years (Sallis et al, 1997), can improve all health-related physical abilities considerably.

Aerobic dancing has been exceptionally popular in recent decades, particularly among women. Most studies have dealt with the influence of aerobic dancing on one's cardiorespiratory capacity, since the improvement of this capacity reduces the likelihood of the development of cardiovascular disorders. However, studies involving adults have proven that aerobic dancing does not only have a positive impact on one's cardiorespiratory capacity (Rockfeller & Burke, 1979), but also on one's other physical abilities (Hooper & Noland, 1984; Silvestri & Oescher, 1990). Moreover, it acts favorably on an individual's psychology and decision-making to engage in other forms of aerobic exercise as well (Watterson, 1984).

Aerobic dance intervention programmes applied on children aged 8-12, have shown the positive effects of aerobic dancing on health-related physical abilities (Werner & Durham, 1988; McIlroy et al, 1989; Ignico & Mahon, 1995) and that children accept such programmes easily and with pleasure (Kremenitzer, 1990). Silvestri & Oescher (1990) showed that the application of

an aerobic dance intervention programme on a sample of adults had positive changes in health-related physical abilities.

The application of an aerobic dance programme on children of the second and fifth grades of primary school (McIlroy et al, 1989) for a period of 8 weeks showed a considerable improvement in all health-related physical abilities of the experimental group.

According to Lehnhard, Butterflield, Beckwith and Marion (1992), the boys and girls of their control group, aged 6 and 7, had a better cardio-vascular performance and a worse body composition, compared to the equivalent children of the national sample. Also the boys of the control group performed more abdominal exercises than the boys of the national sample, while the girls of the control group had a better flexibility than the boys of the control group and the girls of the national sample.

In one of their studies, Bischof and Lewis (1987) report that concerning body composition, only 22% of the children of their sample met by half the Illinois University standards, meaning that they had an acceptable level. As for cardio-vascular endurance, only 25-48% of the boys and 17-31% of the girls had an acceptable level. The results were better, concerning hip flexibility and abdominal endurance. The percentage of the children, who needed treatment, scoring below 25%, was between 9-45%.

In regard to the intensity of aerobic exercise in children, Cotton and Goldstein (1997) suggest the application of the same level of intensity, duration and frequency of aerobic exercise, for both adults and children. This suggestion was supported by Rowland (1985) after re-examining eight relevant studies. In six of them, the intensity, duration and frequency of aerobic exercise was the same for both adults and children. The findings of the above studies revealed a significant improvement of aerobic abilities.

Although the level of health-related physical abilities is low, even among primary school children - which can be improved through aerobic exercise - very few researches have dealt with the subject in relation to children of the first grade of primary school.

The purpose of the present study was a) to evaluate the level of health-related fitness in children of the first grade of primary school, 6 to 7 years old before and after the application of an intervening aerobic dance program and b) to use the results of the study, for the creation of typical values corresponding to the Greek reality.

2. METHODOLOGY

2.1. Sample

The research involved 39 pupils of the first grade of primary school, between the ages of 6 and 7 (M=6.6, SD=0.2). Of these, 20 (12 boys and 8 girls) were the experimental group and the remaining 19 (13 boys and 6 girls) were the control group. The experimental group followed an aerobic dance intervention programme while the control group only followed the school's physical education programme. None of the children participated in kinetic activities out of school. Also, no dietary suggestions were provided. Finally all the students were given a written permission by their parents to participate in the program, having been informed about it and its importance.

2.2. Measurements

In the evaluation of the pupils' physical abilities, the Prudential Fitnessgram (Cooper Institute for Aerobics Research, 1992) battery was used, which is recommended as appropriate by the American Alliance for Health, Physical Education, Recreation and Dance for children aged 5 to 17. For cardiorespiratory endurance, no time standards are recommended but the completion of 402m distances with running and walking. All children were measured before and after the intervention programme in accordance to the protocol in the following tests:

1**. Strength -** endurance **of abdominal muscles**: The "Curl Ups" test was used to measure this ability.

2. **Flexibility of trunk extensor**: The "Trunk Lift" test was used to measure this ability.

3. **Flexibility of the posterior femoral muscles**: The "Back Saver Sit and Reach" test was used to measure this ability.

4. **Strength/ endurance of the upper part of the body**: The "90-degree Push-Ups" test was used to measure this ability.

5. **Cardiorespiratory endurance**: The "One mile Walk-run" test was used to evaluate this ability, adjusted to the 6-7-year age group. An electronic stopwatch was used to measure the time that was required for the children to cover a distance of 402.25 meters running or also walking in between.

6. **Body composition**: A skin fold calliper measurement of the triceps and calf muscle was carried out in order to determine the children's body composition. A Harpenden type skinfold calliper was used to measure the percentage of bodyfat.

2.3. Initial and final measurements procedure

The initial and final evaluation of the elements related to the physical fitness, which promotes health, was carried out within a school environment. Each child was individually assessed and was provided with specific instructions before the beginning of each test, in accordance to the battery protocol. It was emphasized that s/he should perform each test as best as s/he could.

2.4. Intervention programme

After the initial measurements, the experimental group followed the aerobic dance programme for twelve weeks, three times per week, as proposed by Hinson (1995), for 45 minutes per class. The control group only followed the school's physical education programme.

2.5. Statistical analysis

Initially the One-Way Anova analysis was applied to check whether there were any statistically significant differences in the physical abilities between the experimental group and the control group at the initial measurement. According to the results it appeared that any differences were not statistically significant. Therefore, the members of the two groups were considered to be

characterized by the same level of development as to the physical abilities, which were studied before the commencement of the programme.

The Anova repeated measures analysis for independent samples was then applied, considering two different variables, one of which was repeated for each physical ability individually. The analysis model (2X2X2) included the variable "Measurement" (initial - final) as the dependent variable and the variables "Group" (experimental - control) and "Sex" (boys – girls) as the independent variables. For the statistics analysis, the program used was the descriptive statistics with middle terms, from the statistic packet SPSS.

3. RESULTS

The statistical analysis of the results revealed a significant improvement of the boys of the experimental group in relation to the boys of the control group in all abilities tested (table 1).

TABLE 1: MEANS, STANDARD DEVIATION, F AND P OF VARIABLES AT THE INITIAL AND FINAL MEAREMENT OF BOYS

		Initial		**Final**			
Physical abilities	**Team**	**M**	**SD**	**M**	**SD**	**F**	**P**
Abdominal muscle endurance	Experimental	24,33	±6,88	39,08	±5,73	54,87	.001
	Control	27,00	±5,86	23,54	±5,19		
Trunk flexibility	Experimental	16,31	±4,68	23,43	±3,48	112,68	.001
	Control	15,26	±2,46	15,61	±2,40		
Flexibility of the right posterior femoral muscle	Experimental	13,92	±4,89	20,67	±4,23	139,11	.001
	Control	12,88	±3,50	11,77	±3,11		
Flexibility of the left posterior femoral muscle	Experimental	14,24	±3,03	19,63	±3,63	74,05	.001
	Control	13,65	±3,21	12,35	±3,54		
Upper-body strength	Experimental	1,17	±1,47	7,00	±2,41	243,98	.001
	Control	0,85	±0,80	0,46	±0,66		
Cardio respiratory endurance	Experimental	2,59	±0,43	2,28	±0,29	44,15	.001
	Control	2,50	±0,32	2,56	±0,33		
Sum of the skin folds of the triceps and calf muscle	Experimental	26,41	±9,29	24,25	±8,69	60,23	.001
	Control	26,88	±3,43	27,82	±3,29		

The statistical analysis of the results revealed a significant improvement of the girls of the experimental group in relation to the girls of the control group in all abilities tested (table 2).

TABLE 2: MEANS, STANDARD DEVIATION, F AND P OF VARIABLES AT THE INITIAL AND FINAL MEASUREMENT OF GIRLS

		Initial		**Final**			
Physical abilities	**Team**	**M**	**SD**	**M**	**SD**	**F**	**P**
Abdominal muscle endurance	Experimental	24,38	±7,71	38,50	±4,87	30,59	.001
	Control	26,50	±7,09	22,67	±5,92		
Trunk flexibility	Experimental	17,52	±5,49	23,81	±2,93	12,91	.05
	Control	17,51	±3,37	18,50	±3,58		
Flexibility of the right posterior femoral muscle	Experimental	12,91	±5,54	21,25	±5,26	72,89	.001
	Control	14,83	±2,14	14,08	±2,25		
Flexibility of the left posterior femoral muscle	Experimental	12,70	±6,06	20,13	±4,89	34,47	.001
	Control	14,41	±3,58	13,08	±3,09		
Upper-body strength	Experimental	1,75	±1,28	6,75	±2,49	48,10	.001
	Control	0,83	±0,75	0,67	±0,82		
Cardio respiratory endurance	Experimental	2,48	±0,29	2,23	±0,14	17,13	.05
	Control	2,53	±0,29	2,58	±0,31		
Sum of the skin folds of the triceps and calf muscle	Experimental	26,60	±2,87	25,44	±2,67	10,81	.05
	Control	24,82	±3,41	25,95	±3,32		

4. CONCLUSION

The aim of the present study was a) to evaluate the health-related physical fitness level of pupils aged 6 to 7 before and after the application of an aerobic dance intervention program and b) use the results of the study for the creation

of typical values corresponding to the Greek reality.

The reason for choosing aerobic dancing as a means of improving health-related physical fitness elements was that children would participate (Kremenitzer, 1990) with pleasure (McIllroy, et al, 1989; Kremenitzer, 1990; Ignico & Mahon, 1995). Moreover, such programme contributes to children's cognitive and emotional development (Brodie & Britwistle, 1990) as well as to the development of kinetic skills. These are considered essential for the establishment of a kinetic basis for children, and the facilitation of their participation in athletic skills in upper grades of primary education.

The initial measurements showed that the performance of both the experimental and the control group were not so encouraging, compared to the respective values of the Fitnessgram test. More specifically: a) the performance of both boys and girls in the flexibility of the muscles of the hips, in upper body strength the strength /endurance and body composition, children's scores were lower than the Fitnessgram test standards, b) trunk flexibility was relatively good, which is within the Fitnessgram test standards and c) both sexes had a much better performance in strength and endurance of the abdominal muscles (tables 1 and 2).

With the implementation of an aerobic dance intervention programme, as revealed by the findings, there was an improvement of all health-related physical fitness parameters for boys and girls only of the experimental group. Specifically:

a. There was an improvement in the strength / endurance of the abdominal muscles. This improvement may have been due to the exercising of the abdominal muscles, which was carried out in every training unit with specific exercises. On the contrary, the performance of the control group declined. The findings of the study agree with the findings of other studies (Werner & Durham, 1988; McIllroy, Roundy & Jacobson, 1989; Ignico & Mahon, 1995), according to which abdominal muscle endurance improved in experimental groups, while the control group showed a decline or a statistically non-significant difference.

b. The flexibility of the muscles of the back and of the hip considerably improved in the pupils of the experimental group boys and girls. This improvement may have been due to the special exercise of the two muscle groups with dorsal muscle and distention exercises respectively. The findings of the study agree with the findings of studies on children, which show improvement in the experimental group and a decline (Werner & Durham, 1988; Ignico & Mahon, 1995) or constant values in the control group (McIllroy et all, 1989). In the Silvestri and Oescher (1990) study, which used a sample of adults, it was shown that the flexibility ability improves after the implementation of an aerobic dance programme, both when weights are used simultaneously and when they are not used.

c. The experimental group showed a considerable improvement in upper body strength, which may have been due to the exercising of this ability with exercises aimed at strengthening the muscles of the arms. A comparison with other studies is not possible because the strength of the arms after training has not been measured on children by other researchers. In their study on a sample of adults, Silvestri and Oescher (1990) showed that the strength of the hands increased after the application of an aerobic dance programme with the simultaneous use of lightweights.

d. As the findings showed, the cardiorespiratory endurance of the experimental group considerably improved after the application of the programme since it covered, in the final measurement, the distance of 402.25 meters in less time compared to the initial measurement. However, the control group also showed an improvement and this may be due to its participation in the physical education classes at school, as well as to the variable "age". As Martin (1994) says, children's endurance increases, due to maturation, from 7 to 10 years of age, both in boys and girls. The improvement of the cardiorespiratory endurance of the experimental group may be due to the learning of the correct force distribution and self-motivation. This view is also supported by Ignico and Mahon (1995), who, after a study, ascertained an improvement of the cardiorespiratory endurance of children. Similar studies (Werner & Durham, 1988; McIllroy et al, 1989; Albert et al.,

1990) have shown an improvement of the cardiorespiratory endurance in both groups with the improvement of the experimental group being better than the improvement of the control group.

e. Although no dietary suggestions were provided in the course of the programme, the composition of the body appeared to be favorably affected by the application of the aerobic programme, as the experimental group showed a decrease, - even was lower than the Fitnessgram standards- of the thickness of the skinfolds as opposed to the control group which showed an increase of the thickness of the skinfolds. The result of the study is also supported by the result of the study of Werner and Durham (1988), who ascertained a positive effect, after the implementation of an aerobic programme with the simultaneous provision of dietary suggestions, on the body composition of the sample. However, the result of the study conflicts with the result of the study of Ignico and Mahon (1995), who applied a similar programme but on older children. From the findings of the study it was shown that an aerobic dance programme provides us with the potential to improve all health-related physical abilities, each to a different extent, of pupils from 6 to 7 years old. The application of the program showed that such aerobic dance programs are easy for physical education instructors to design and for pupils to take part in, even at the first grades of primary education. We would say that today the implementation of such programs is imperative due to the modern way of living, which is characterized by the absence of any kinetic activity.

REFERENCES

Albert, B., Field, T., Goldstein, S., & Perry, S. (1990). Aerobic Enhances Cardiovascular Fitness And Agility in Preschoolers, *Health Psychology*, Vol. 9, 48-56.

Biering-Sorensen, F., Bendix, J., Jorgensen, K., Manniche, C., & Nielsen, H., (1994). Physical activity fitness and back pain, In C. Bouchard, R.J. Shepard & T. Stephens (Eds), *Physical Activity Fitness and Health* (pp 737-748). Champaign IL: Human Kinetics.

Bischoff, J. & Lewis, A. (1987). A Cross-Sectional Study of Fitness Levels in a Movement Education Program, *Research Quarterly for Exercise and Sport*, Vol. 58, No. 3, 348-354.

Brodie, D. A. & Birtwistle, G.E. (1990). Children's Attitudes to Physical Activity, Exercise, Health and Fitness before and after a Health – related Fitness Measurement Programme, *International Journal of Physical Education*, Vol. 27, No. 2, 10-14.

Cooper Institute for Aerobics Research (1992). The prudential Fitnessgram test administration manual, Dallas: Author.

Corbin, C. B. & Lindsey, R. (1984). Concepts of Physical Activity, Buduque, IA: Wm. C. Brown.

Cotton, R. T. & Goldstein, R. L. (1997). Aerobics instructor manual, The resource for group fitness instructors, USA: American Council on Exercise.

Eickhoff J., Thorland W. & Ansorge C. (1983). Selected physiological and psychological effects of aerobic dancing among young adult women, *Journal of Sports Medicine*, Vol. 2, 273- 280.

Harsha, D. W. The Benefits of Physical Activity in Children, *Journal of Medical Science*, Vol. 310, S109-113.

Hooper, P. L. & Noland, B. J. (1984). Aerobic dance program improves cardiovascular fitness in men, *Physical and Sports medicine*, Vol. 12, No. 5, 132-135.

Ignico, A. A. & Mahon, D. A. (1995). The Effects of Physical Fitness Program on Low – Fit Children, *Research Quarterly for Exercise and Sport*, Vol. 66, 85-90.

Kremenitzer, P. J. (1990). Aerobic Fitness Dancing in the Elementary Schools, *Journal of Physical Education, Recreation and Dance*, Vol. 61, 89-90.

Lehnhard, R. H., Lehnhard, A. R., Butterflield, A. S., Beckwith, M. D., & Marion, E. S. (1992). Health-Related Physical Fitness Levels of Elementary School Children Aged 5-9, *Perceptual and Motor Skills*, Vol. 75, 819-826.

Martin P. (1994). Training In The Children's And Adolescent Age (in Greek) Thessalonique – Greece, Salto.

McIllroy, H. B., Roundy, S. E. & Jacobson, C. P. (1989). A Progressive Aerobic Program for Elementary Aged Children, *The Physical Educator*, Vol. 46, 21-26.

Paffenbarger, R. S., Hyde, P. T., Wing, A. L. & Hsieh, C. (1986). Physical Activity, all-cause mortality and longevity of College of Alumni, *New England Journal of Medicine*, Vol. 314, 605-613.

Pangrazi, P. P. (1997). Teaching Elementary Physical Education: A Handbook for the Classroom Teacher. USA: Allyn and Bacon.

Proios M. (1988). Athletic Preparation In The Gymnastics (in Greek), Thessalonique – Greece, Salto.

Rockfeller, K. A. & Burke, E. J. (1979). Psycho – physiological analysis of an aerobic dance programme for women. British Sports Medicine, Vol. 13, 77-80.

Rowland, T. W. (1985). Aerobic responses to endurance training in prepubescent children: critical analysis, *Medicine Science in Sports and Exercise*, Vol. 17, 493-497.

Sallis, J. & McKenzie, T. (1991). Physical Education's Role in Public Health. Research Quarterly for Exercise and Sport, 62, 124-137.

Sallis, J., McKenzie, T., Alcaraz, J., Kolody, B., Faucette, N. & Hovell, M. (1997). The effects of a 2-Year Physical Education Program (SPARK) on Physical Activity and Fitness in Elementary School Students, *American Journal of Public Health*, Vol. 87, No. 8, 1328-1334.

Sheefeldt, V. & Vogel, P. (1987). Children and fitness: a public health perspective, a response, *Research Quarterly for Exercise and Sport*, Vol. 58, 331-333.

Silvestri, L. & Oescher, J. (1990). Use of Aerobic Dance and Lights Weights in Improving Selected Measures of Strength, Endurance and Flexibility, *Perceptual and Motor Skills*, Vol. 70, 595-600.

Watterson, V. (1984). The effects of aerobic dance on cardiovascular fitness. *Physician and Sport Medicine,* Vol. 12, No. 10, 138-145.

Werner, P. & Durham, R. (1988). Health Related Fitness Benefits in Upper Elementary School Children in a daily Physical Education Program, *The Physical Educator*, Vol. 45, 89-93.

The Cyprus Journal of Sciences, Vol. 3, 2005/47-59

BOVINE LEUKEMIA AS AN EXPERIMENTAL MODEL OF VIRAL T-CELL LEUKEMIA IN HUMANS

R. RUSSEV, E. SHIKOVA, P. DIMITROV, K. SIMEONOV,[*]
D. IVANOV,[**] D. PORTETELLE and R. KETTMANN[***]

ABSTRACT

Human T-cell leukemia virus type 1 (HTLV-1), the etiological agent of T-cell leukemia in humans and bovine leukemia virus (BLV), the causative agent of enzootic bovine leukosis, are closely related. Therefore BLV system is an excellent animal model to study HTLV-1 replication and leukemogenesis in vivo. The present study aims to get information on biological properties of BLV Tax and Rex regulatory proteins and R3 and G4 accessory proteins by analyzing their subcellular localization in virus producing cells using immunofluorescence and immunoelectron microscopy analyses. We indicated localization of BLV Tax, Rex and R3 proteins both in the cytoplasm and nucleus of BLV-producing cells. Our findings of G4 localized only in cytoplasm, in contrast with its dual localization pattern reported by other authors, could be due to the specificity of the cell types used in our experiments and/or to the fact that these cells are virus-producing.

Keywords: bovine leukemia virus, human T-cell leukemia virus, regulatory and accessory proteins subcellular localization, immunofluorescence, electron microscopy, immunogold labeling

1. INTRODUCTION

Human T-cell leukemia virus type 1 (HTLV-1), the etiological agent of T-cell leukemia in humans, and bovine leukemia virus (BLV), the causative agent of enzootic bovine leukosis, are closely related. They belong to the same subfamily of retroviruses, share a similar genomic organization and biological

[*] Institute of Experimental Pathology and Parasitology, Bulgarian Academy of Sciences, Bulgaria
[**] National Diagnostic and Research Veterinary Institute, Bulgaria
[***] Professors of Agronomy, University of Agronomic Sciences, Gembloux, Belgium

properties, infect and transform hematopoietic cells, although, both viruses are deprived of "onc" genes. Therefore BLV system is an excellent animal model allowing the study of HTLV-1 replication and leukemogenesis in vivo (Semmes and Hammarskjold, 1999, p. 17) and (Willems et al., 1999, p. 139).

The genome of BLV, like that of HTLV-1, in addition to the classical structural genes of retroviruses, contains a region called "X", located between env gene and 3' long terminal repeat (LTR), coding for the regulatory proteins Tax and Rex and for the accessory proteins p12I , p13II and p30II for HTLV-1 and R3 and G4 for BLV (Alexandersen et al.,1993, p. 39) and (Berneman et al., 1992, p. 3005) and (Ciminale et al., 1992, p. 1737) and (Koralnik et al., 1992, p. 8813). Tax and rex genes are involved in transcriptional and posttranscriptional regulation and are considered to be responsible for the virus expression and cellular immortalization (Kettmann et al, 1994, p.39) and (Willems et al., 2000, p. 1787) and (Yoshida, 1996, p.S63). However, much less is known regarding the role of accessory genes. Previous studies showed that HTLV-1 p12I is with oncogenic potential (Franchini et al., 1993, p. 7701) and is required for the infection of primary quiscent lymphocytes (Albrecht et al., 2000, p. 9828), p13II has been shown to induce changes in mitochondrial architecture (Ciminale et al., 1999, p. 4505) and p30II – to regulate transcription (Zhang et al, 2000, p. 11270) and (Zhang et al., 2001, p.9885). The function of BLV accessory proteins R3 and G4 is unclear. There are speculations that R3 might modulate Rex function and G4 may belong to the immortalizing class of oncogenes (Lefebvre et al., 2002, p. 7843).

In our previous study (Roussev et al.,1993, p.129) we determined by immunofluorescent analysis subcellular localization and dynamics of BLV p24 and gp51 synthesis in virus producing cells in order to gain insight into the function of these proteins. Indeed, the identification of the localization of a protein is often the first step leading to its functional characterization. The present study continues characterization of BLV proteins and aims to get additional information on the biological properties of BLV Tax and Rex regulatory proteins and R3 and G4 accessory proteins by analyzing their subcellular localization in virus producing cells.

2. MATERIALS AND METHODS

2.1. Cells

A highly virus producing clone of the line FLK-BLV(Altaner et al.,1985, p. 107) was kindly provided by Dr. C. Altaner (Slovak Academy of Sciences, Bratislava) and was maintained under standard conditions in medium DMEM (Flow) supplemented with 10% tryptose phosphate broth (TPB) and 10% heat-inactivated fetal bovine serum (FBS) (Flow).

Short term lymphocyte (STL) culture was obtained from serum positive for BLV cows with clinical symptoms of the enzootic bovine leukosis and 45 000 leukocytes/µl of peripheral blood. STL cultures from BLV seronegative cows were used as negative controls. The lymphocytes were separated by density gradient centrifugation on Ficoll-Hypaque (Pharmacia) as previously described (Stone et al.,1994, p. 1057) and were cultivated in RPMI 1640 or DMEM (Flow) supplemented with 10% TPB and 15% FBS (Ferrer et al.,1981, p. 9).

2.2. Antibodies

Monoclonal antibodies against Tax and Rex proteins and rabbit polyclonal anti-R3 and anti-G4 antibodies (kindly provided by Prof. Portetelle D., the Faculty of Agronomy in Gembloux, Belgium) were used as primary antibodies in immunofluorescence (IF) and electron microscopy (EM) analyses. FITC-conjugated (for IF analysis) and colloidal gold particles-conjugated (for EM analysis) anti-mouse or anti-rabbit immunoglobulin respectively were used as secondary antibodies.

2.3. Immunofluorescence analysis

By indirect immunofluorescence the production of viral proteins Tax, Rex, R3 and G4 were visualized in BLV-infected FLK and STL cultures. The lymphocytes of 72 h STL culture were separated from the medium by centrifugation and were attached to poly-l-lysyne (0.1%) pretreated glass coverslips. Both the lymphocytes and the cells from the FLK culture were fixed in cold methanol-acetone (3:7) for 5 min at $-2O^{o}C$. The fixed cells were incubated with the antibodies against Tax, Rex, R3 and G4 as primary antibodies for 30 min, followed by washing and incubation for another 30 min

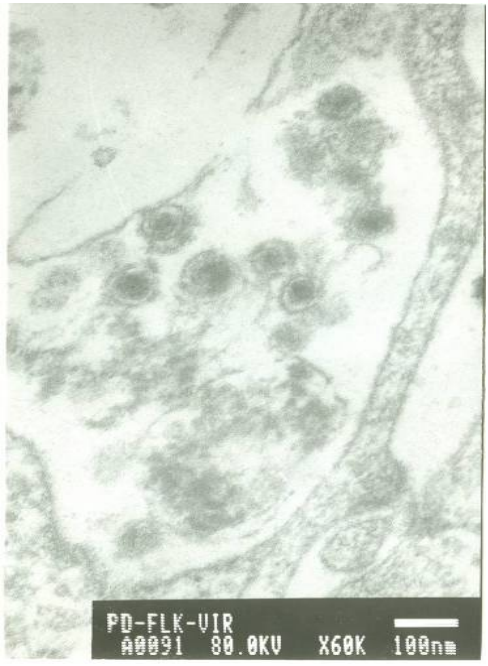
in FITC-conjugated secondary antibodies (Sigma). The samples were examined with a Zeiss microscope. In order to demonstrate the specificity of the labeling, control experiments were performed by using normal serum instead of primary antibody.

2.4. Electron microscopy

FLK and 72 h STL cells were fixed for 1 h with 1.6% glutaraldehid, postfixed with 1% OsO4 and embedded in Epon for conventional electron microscopy in order to verify virus production in these cells (Fig.1).

For the immunocytochemical study, the cells were fixed in 4% paraformaldehyde, dehydrated in series of increased concentrations of ethanol and embedded in antigens' activity preserving low temperature embedding resin Lowikryl K4M (Serva) (Carlemalm et al.,1980, p. 740). Ultrathin sections, mounted on golden grids, were incubated with the primary antibodies mentioned above for 30 min at room temperature. The immune complexes were detected using anti-mouse/rabbit/ immunoglobulin conjugated to colloidal gold particles (10nm in diameter) (Sigma). After washing the grids were stained with uranyl acetate. Controls were carried out by the same way, except the incubation in the antibodies was replaced by incubation in normal serum. The samples were observed on JEOL-1200 EX electron microscope.

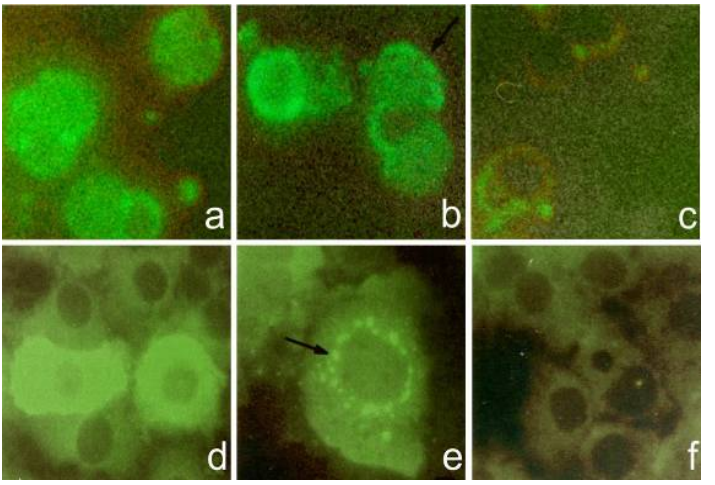
FIGURE 1: ACCUMULATION OF BLV PARTICLES IN THE EXTRACELLULAR SPACE OF FLK CULTURE. BAR 100



3. RESULTS AND DISCUSSION

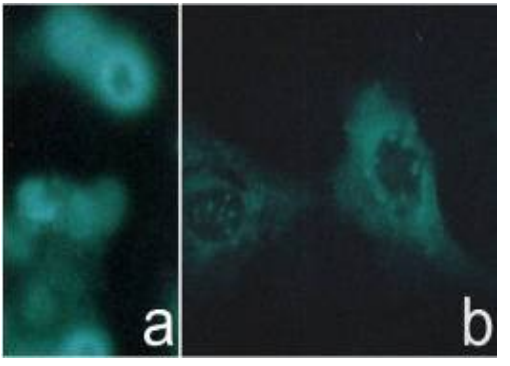
Immunofluorescence (IF) analysis of STL and FLK cultures visualized BLV Tax protein both in the nucleus and cytoplasm of lymphocytes (Fig.2 a,b) and FLK (Fig.2 d, e) cells.

FIGURE 2: IF ANALYSIS OF SUBCELLULAR LOCALIZATION OF BLV TAX PROTEIN IN STL (a, b) AND FLK (d, e) CELLS. CONTROLS IN STL (c) AND FLK (f) CELLS



The signal was more intensive in the cytoplasm where Tax was either diffusely distributed or concentrated along the nuclear membrane as pearl-like conglomerates (arrows). BLV Rex Protein exhibited distribution pattern in STL (Fig.3a) and FLK (Fig.3b) cells similar to that of Tax.

FIGURE 3: IF ANALYSIS OF SUBCELLULAR LOCALIZATION OF BLV REX PROTEIN IN STL (a) AND FLK (b) CELLS.
(Controls: see Figure 5)



We speculate that concentration of BLV regulatory proteins in perinuclear conglomerates is a step required for their transport to the nucleus. These proteins might initially be oversynthesized and stored in cytoplasmic vacuoles for a future transport to the nucleus and transactivation of provirus expression. To verify the subcellular localization of Tax and Rex proteins electron microscopy (EM) analysis using immunogold labeling was performed in BLV-infected STL and FLK cells. Gold particles were visualized as clusters within the cytosol in the area of the free ribosomes and in/or close to cytoplasmic vacuoles (Fig.4a, b) of the cells. In the nucleus immunolabeling was localized in the area of the decondensed chromatin (Fig.4c). Nucleolus and condensed chromatin were free of gold particles labeling.

Our studies of subcellular distribution of BLV regulatory proteins indicated localization of these proteins both in the cytoplasm and the nucleus of BLV-producing STL and FLK cells. The nuclear localization of Tax and Rex proteins may account for the Transactivation of cellular genes involved in the control of cell proliferation. These findings are in agreement with previous studies on distribution pattern of BLV, HTLV and HIV regulatory proteins in virus-nonproducing cells (Kubata et al., 1996, 502) and (Nosaka et al., 1989, p. 9798) and (Meertens et al., 2004, 43307) and (Semmes and Jeang, 1996, p. 6347) and (Willems et al., 1998, p. 2165) and (Zauli et al., 1996, p.109).

In order to obtain information on function of BLV accessory proteins R3 and G4 we performed IF analysis of sub cellular distribution of these proteins in virus-producing cells. Our results indicated that R3 protein staining signal was stronger in the nucleus than in the cytoplasm of both STL (Fig.5a) and FLK (Fig.5b) cells. In contrast, G4 protein was visualized in the cytoplasm but not in the nucleus of infected cells (Fig.5c, d).

Our data concerning subcellular localization of R3 protein in BLV-producing cells are in agreement with previous studies in virus-nonproducing cells. For instance, Lefebvre et al. (2002, p.7843) detected BLV R3 protein in the cytoplasm and nucleus of HeLa Tat cells transfected with plasmid coding for R3 and suggested that BLV R3 could act as a regulator of the posttranscriptional activity of Rex. In addition, a localization pattern similar to BLV R3 was reported for HTLV-1 p12I (Koralnik et al., 1993, p.2360). At the same time Lefebvre et al. (2002, p.1400) detected in G4-transfected HeLa Tat

cells dual localization pattern of G4 protein – in cytoplasm (in mitochondria) and in the nucleus. According to these authors presence of G4 in nucleus suggests its possible role as a transcriptional factor as reported by Alexandersen et al. (1993, p.39).

FIGURE 4: EM IMMUNOGOLD LABELLING OF BLV REGULATORY PROTEINS TAX IN CYTOPLASMIC VACUOLES (a, b) AND REX IN THE NUCLEUS (c) OF FLK CELLS. CV – CYTOPLASMIC VACUOLES, (n – nucleus, nu-nucleolus). BAR 200 nm

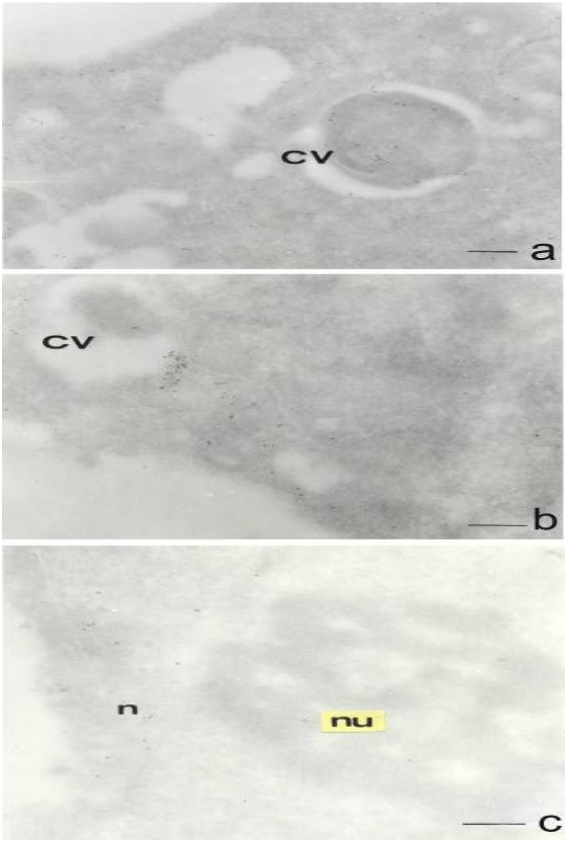
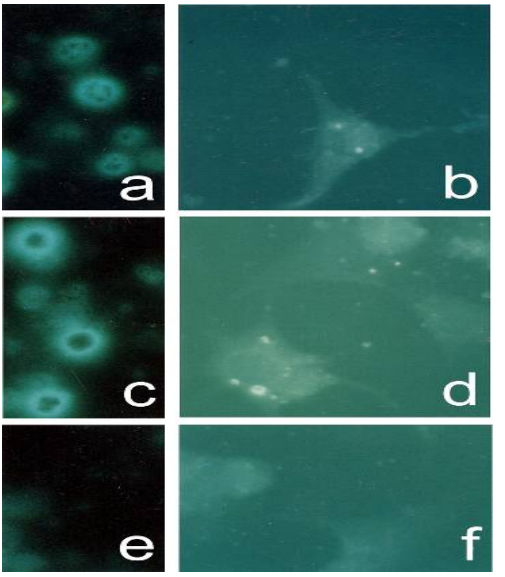


FIGURE 5: IF OF SUBCELLULAR DISTRIBUTION OF BLV ACCESSORY PROTEINS: R3 IN STL (a) AND IN FLK (b); G4 IN STL (c) AND FLK (d) CELLS; CONTROLS: STL (e), FLK (f)



Both nuclear and mitochondrial signals were also reported for HTLV-1 p13II (Ciminale et al., 1999, p.4505) and (D,Agostino et al., 1997, p. 75) and (Koralnik et al., 1993, p. 2360) and (Lefebvre et al., 2002, p.1400). Our findings of G4 localized only in cytoplasm could be due to the specificity of the cell types used in our experiments and/or to the fact that these cells are virus-producing. In our case it is possible G4 interacts with other viral components and this may disturb its transport to the nucleus.

In conclusion, our report provides additional data, obtained in BLV-producing cells, concerning biological properties of BLV regulatory (Tax and Rex) and accessory (R3 and G4) proteins. The analogies and differences between subcellular localization of these proteins in BLV-producing and –nonproducing cells on one hand, and HTLV-1 X region proteins on the other hand, could help us in better understanding of function of these proteins and of leukemogenesis induced by related HTLV-1 and BLV.

REFERENCES

Albrecht, B., Collins, N.D., Burniston, M.T., Nisbet, J.W., Ratner, L., Green, P.L., Lairmore, M.D. (2000). Human T-lymphotropic virus type 1 open reading frame I p12I is required for efficient viral infectivity in primary lymphocytes, *Journal of Virology*, Vol. 74, 9828-9835.

Alexandersen, S., Carpenter, S., Christensen, J., Storgaard, T., Viuff, B., Wannemuehler, Y., Belousov, J., Roth, J. (1993). Identification of alternatively spliced mRNAs encoding potential new regulatory proteins in cattle infected with bovine leukemia virus, *Journal of Virology*, Vol. 67, 39-52.

Altaner, C., Ban, J., Zajac, V., Rosenthal, H., Kettmann, R., Burny, A. (1985). Isolation and characterization of cell clones producing various amounts of bovine leukosis virus, *Folia Biologica (Praha),* Vol. 31, 107-114.

Berneman, Z.N., Gartenhaus, R.B., Reitz, M.S., Blattner, W.A., Manns, A., Hanchard, B., Ikehara, O., Gallo, R.C., Klotman, M.E. (1992). Expression of alternatively spliced human T-lymphotropic virus type I pX mRNA in infected cell lines and in primary uncultured cells from patients with adult T-cell leukemia/lymphoma and healthy carriers, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 89, 3005-3009.

Carlemalm, E., Villiger, W., Acetarin , J. (1980). Advances in specimen preparation for electron microscopy. A novel low temperature embedding resins and reformulated, Vestopal. *Experiencia*, 36, 740-744.

Ciminale, V., Pavlakis, G.N., Derse, D., Cunningham, C.P., Felber, B.K. (1992). Complex splicing in the human T-cell leukemia virus (HTLV) family of retroviruses: novel mRNAs and proteins produced by HTLV type I, *Journal of Virology*, Vol. 66, 1737-1745.

Ciminale, V., Zotti, I., D,Agostino, D.M., Ferro, T., Casareto, I., Franchini, G., Bernardi, P., Chieco-Bianchi, I. (1999). Mitochondrial targeting of the p13II protein coded by the x-II ORF of human T-cell leukemia/lymphotropic virus type I (HTLV-I), *Oncogene,* Vol. 18, 4505-4514.

D,Agostino, D.M., Ciminale, V., Zotti , I., Rosato, A., Chieco-Bianchi, I. (1997). The human T-cell lymphotropic virus I Tof protein contains a bipartite nuclear localization signal that is able to functionally replace the amino-terminal domain of Rex, *Journal of Virology*, Vol. 71, 75-83.

Ferrer, J., Cabradiella, C., Gupta, P. (1981). Use of a feline cell line in the syncytia infectivity assay for the detection of bovine leukemia virus in cattle, *American Journal of Veterinary Research*, Vol. 42, 9-14.

Franchini, G., Mulloy, J.C., Koralnik, I.J., Lo Monico, A., Sparkowski, J.J., Andresson, T., Goldstein, D.J., Schlegel, R. (1993). The human T-cell leukemia/lymphotropic virus type I p12I protein cooperates with the E5 oncoprotein of bovine papillomavirus in cell transformation and binds the 16-kilodalton subunit of the vacuolar H+ ATPase, *Journal of Virology*, Vol. 67, 7701-7704.

Kettmann, R., Burny, A., Callebaut, I., Droogmans, L.,Mammerickx, M., Willems, L. and Portetelle, D. (1994). *Bovine Leukemia Virus. In: The Retroviridae*, 3, ed. Levy, J., Plenum Press, New York, 39-81.

Koralnik, I.J., Gessain, A., Klotman, M.E., Lo Monico, A., Berneman, Z.N., Franchini, G. (1992). Protein isoforms encoded by the pX region of human T-cell leukemia/lymphotropic virus type I, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 89, 8813-8817.

Koralnik, I.J., Fullen, J., Franchini, G. (1993). The p12I, p13II, and p30II proteins encoded by human T-cell leukemia/lymphotropic virus type I open reading frames I and II are localized in three different cellular compartments, *Journal of Virology*, Vol. 67, 2360-2366.

Kubata, S., Hatanaka, M., Pomerantz, R.J. (1996). Nucleo-cytoplasmic redistribution of the HTLV-I Rex protein: alterations by coexpression of the HTLV-I p21x protein, *Virology*, Vol. 220, 502-507.

Lefebvre, L., Ciminale, V., Vanderplasschen, A., D,Agostino, D., Burny, A., Willems, L., Kettmann, R. (2002). Subcellular localization of the bovine leukemia virus R3 and G4 accessory proteins, *Journal of Virology*, Vol. 76, 7843-7854.

Lefebvre, L., Vanderplasschen, A., Ciminale, V., Heremans, H., Dangoisse, O., Jauniaux, J., Toussaint, J., Zelnik, V., Burny, A., Kettmann, R.and Willems, L. (2002). Oncoviral bovine leukemia virus G4 and human T-cell leukemia virus type 1 p13II accessory protein interact with farnesyl pyrophosphate synthetase, *Journal of Virology*, Vol. 76, 1400-1414.

Meertens, L., Chevalier, S., Weil, R., Gessain, A., Mahieux, R. (2004).A 10-amino acid domain within human T-cell leukemia virus type 1 and type 2 tax protein sequences is responsible for their divergent subcellular distribution, *The Journal of Biological Chemistry*, Vol. 279, 43307-43320.

Nosaka, T., Siomi, H., Adachi, Y., Ishibashi, M., Kubota, S., Maki, M., Hatanaka, M. (1989). Nucleolar targeting signal of human T-cell leukemia virus type I rex-encoded protein

is essential for cytoplasmic accumulation of unspliced viral mRNA, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 86, 9798-9802.

Roussev, R., Polianova, M., Portetelle, D., Ivanovna, O. (1993). Dynamics of mitotic activity and expression of viral proteins gp51 and p24 of bovine leukemia virus producing cells, *Folia Biologica (Praha)*, Vol. 39, 129-136.

Semmes, O.J., Jeang, K.T. (1996). Localization of human T-cell leukemia virus type 1 tax to subnuclear compartments that overlap with interchromatin speckles, *Journal of Virology*, Vol. 70, 6347-6357.

Semmes, O. and Hammarskjold, M. (1999). Molecular pathogenesis of HTLV-I: a current perspective, *ABI Professional Publications*, Arlington, Va., 17-29.

Stone, D., McElwain, T., Davis, W. (1994). Enhanced B-lymphocyte expression of IL-2R alpha associated with T lymphocytosis in BLV-infected persistently cows, *Leukemia*, Vol. 8, 1057-1061.

Willems, L., Grimonpont, C., Kerkhofs, P., Capiau, C., Gheysen, D., Contrath, K., Roussef, R., Mamoun, R., Portetelle, D., Burny, A., Adam, E., Lefebvre, L., Twizere, J., Heremans, H. and Kettmann, R. (1998). Phosphorylation of bovine leukemia virus Tax protein is required for in vitro transformation but not for transactivation, *Oncogene*, Vol. 16, 2165-2176.

Willems, L., Burny, A., Collete, D., Dangoisee, O., Gatot, J., Kerkhofs, P., Lefebvre, L., Merezak, C., Portetelle, D., Twizere, J. and Kettmann, R. (1999). Bovine leukemia virus as a model for human T-cell leukemia virus, *Current Topics in Virology*, Vol. 1, 139-167.

Willems, L., Burny, A., Collete, D., Dangoisse, O., Dequiedt, F., Gatot, J.S., Kerkhofs, P., Lefebvre, L., Merezak, C., Peremans, T., Portetelle, D., Twizere, J.C., Kettmann, R. (2000). Genetic determinants of bovine leukemia virus pathogenesis, *AIDS Research and Human Retroviruses*, Vol. 16, 1787-1795.

Yoshida, M. (1996). Molecular biology of HTLV-I: recent progress, *Journal of AIDS and Human Retroviruses*, Vol. 13, S63-S68.

Zauli, G., Falcieri, E., Robuffo, I., Bosco, D., Marchisio, M., Celeghini, C., Vignoli, M., Capitani, S. (1996). Subcellular localization of the regulatory HIV-I Tat protein produced endogenously by or added exogenously to PC12 rat pheochromocytoma and human Jurkat T lymphoid cells, *Cellular Pharmacology-AIDS Sciences*, Vol. 3, 109-118.

Zhang, W., Nisbet, J.W., Bartoe, J.T., Ding, W., Lairmore, M.D. (2000). Human T-lymphotropic virus type 1 p30II functions as a transcription factor and differentially modulates CREB-responsive promoters, *Journal of Virology*, Vol. 74, 11270-11277.

Zhang, W., Nisbet, J.W., Albrecht, B., Ding, W., Kashanchi, F., Bartoe, J.T., Lairmore, M.D. (2001). Human T-lymphotropic virus type 1 p30II regulates gene transcription by binding CREB binding protein/p300, *Journal of Virology*, Vol. 75, 9885-9895.

The Cyprus Journal of Sciences, Vol. 3, 2005/61-73

NONLINEAR APPROACH FOR THE INVESTIGATION OF THE AFFECTED PEOPLE IN EMERGENCY SITUATIONS

BOYKO RANGUELOV*

ABSTRACT

Nonlinear functions are proposed as descriptive expressions of the social behavior of the affected groups of people in case of extreme critical situations (generated by natural hazards, industrial accidents or terrorist attacks). Five functions are identified up to now, called respectively: "solidarity", "panic", "rumors", "media" and "enthusiasm". The systematic tables of the time duration, sensitivity of the respective function, its interruption/non interruption behavior and the possibilities of the management are created. This is a first attempt to present the social behavior of the affected groups of people during extreme events as deterministic functions. Their properties are investigated. The nonlinearity of the functions is clearly expressed. The possibility to use these functions in the management practice of the extreme situations could be a strong tool for investigation and influence of people's behavior. The analysis performed shows that frequently the combinations of several of these functions could appear, making the management process rather complicated and difficult.

Keywords: affected people groups' behavior, extreme events, nonlinear functions.

1. INTRODUCTION

The development of a strict mathematical approach for the description of the social elements like social behavior and social movements started not a very long time ago. Now this modern approach is in use for many social applications, even for the analysis of emotions (B. Swarts, 2004). The information collected by different sociological agencies about elections, public reaction on the different pure social, economical and/or political issues,

* Joint Research Centre, Institute of the Protection and the Security of the Citizens (IPSC), Hazard Assessment Unit, Ispra, Italy

advertisements influence to the population, etc., and its statistical processing, show some trends, which could sometimes be expressed by the deterministic functional analysis. This approach is much more coherent with the modeling and the different trend analysis. To describe the personal/group behavior and/or to predict the big social groups' behavior in case of extreme events is a difficult task (P. Blaikie, et al., 1994, p.38). The formal mathematical approach generates a new wave of mathematical symbology and the new trends in the recent mathematics theory like groups, rings, strings, membranes, etc. Many mathematical expressions have been built up frequently on different non-linear basis like the theory of chaos, turbulence effects, "strange" attractors, etc.

On the other hand the development of the fast communication systems and powerful computers lead to many useful applications, but also to some paradoxes: For example the calculation of the roulette ball behavior in real time and "practical applications" of this model to earn "easy" money in the casino, or the formulas introduced for calculation of the result of a certain football match. (All these funny (but real) facts appearing from time to time in the mass-media environment just show the advanced development of the science and technology in everyday life). Our target is more practical and humanistic. Using both - the technological and the mathematical booms, to try to represent mathematically (which means rather objective) the general human social behavior in risky situations – e.g. natural hazardous events, terrorist attacks, industrial accidents, etc., which can affect relatively bigger groups of the society (V. Kovachev et al., 1997, p. 47).

2. COMMON CONSIDERATIONS

If such approach is effective – large possibilities appear using the recent technology and communications for the effective management of the crisis events like: human behavior in case of emergency situations in different cases (teracts, industrial accidents, natural catastrophes, etc.). It is known that to find out and to apply (only on the intuitive basis and some personal field observations) the deterministic approach to the social behavior in the risky situation, it is a really hard task (ISDR, 2002). It is important to mention that to collect real relevant data in such situations is really a very difficult, often impossible aim.

This is due to several reasons (objective and subjective):

- Relatively short time of the influence of the hazardous event and/or the threaten agent (if such exists and could be possibly triggered) (V. Kovachev et al. 1997, p.67).
- More important safe-life actions during the hazardous event then the data collection. (It is really impossible to "put" in such situations data collectors or interviewers.). So, the main sources for the relevant information are the investigator's location at the spot of the event and its impressions, occasional photos, pictures, movies, shots, etc. at the moment of the event.
- In the everyday practice the post-event analysis is targeted to discover the generator of the event, and the consequences (mainly the economic part), but almost never to follow the social momentum behavior of the people involved in the hazardous event.

Our task is on the basis of the general considerations, personal or shared experience of the "field" observations, data appearance in different sources, lessons learnt publications (NEDIES Reports, 2001-2004), etc., to try to define reasonable mathematical functions (sometime even descriptive) of the social behavior of the groups of people involved in such emergency situations. There are not so many options concerning the group behavior in the risky situations (K. Sundnes & Birnbaum L., 2003, p. 123) – we identified up to now – several – solidarity and enthusiasm, panic and rumors, mass-media kinds of behavior. Probably some others exist, but they could be dealt with in the future.

All of the described functions have a common property – clearly expressed nonlinear behavior. This is due to the very complex and complicated factors acting during the emergency situation.

The main reasons we consider, are the instability and sensitivity of the group behavior in the extreme situations – very small changes in the input situation could generate big amplitudes to the output function behavior.

3. METHODOLOGY

The methodology is based on several simple principles:

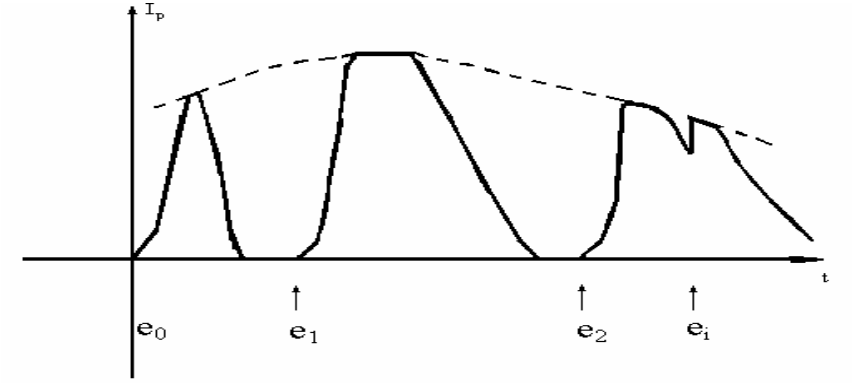
- Graphical expression of the functions based on the different case studies and general lessons learned.
- Time duration estimations of the functions behavior based on the physical measurements and considerations related to the emergency situations generated by the natural or man-made hazards.
- Estimations of the possibility for the situation management.
- The functions are considered valid only for the groups of people located in the epicenter of the risk event (i.e. direct players).

4. GRAPHIC PRESENTATION AND DESCRIPTIONS OF THE FUNCTIONS

4.1. The panic function (fig.1)

This is a time-intensity function, impulsive, relatively short in time (seconds to minutes), generated always in the public (group) society, when a serious threat appears. The initial event (e_0) generates relatively slower increase of the intensity that the following (e_1, e_2, etc.). Each new event triggered more intensive and faster increasing. The short time plateaus could be observed. The decreasing phase is longer for each following event. The interruption of the function is possible. If the next event is closer in the time domain and the effect of the previous event is still lasting, the cumulative effect could be observed (case e_i on the graphic). Going very fast up in the initial phase and slowing down calmly. The trend analysis shows (dashed line), that the trend has a slow increasing to a certain moment and then going down with the time development, but plateaus also could be observed.

FIGURE 1: THE "PANIC" FUNCTION



4.2. The solidarity function (fig.2)

Usually long lasted intensity function (days – weeks). This is a probabilistic function, very sensitive to the new threats, and very irregular, depending on the new threats –events (e_i), after the initial event e_0. The function increases very fast after the first event and has relative smooth plateaus. Any new threat leads to the very fast decreasing (the "safe-life" syndrome), even interruption. The recovery time is also fast. The trend analysis shows slow decrease in time due to the people's accommodation to the threat, but this is not a significant decrease.

4.3. The media function (fig.3)

This is a cumulative probabilistic function, which describes the media reflectance to the risk events and their consequences (by publications and other different forms and reactions – interviews, direct emissions, public and/or expert opinions, public presentations, etc.).

The function is long lasted function (weeks-months). Several similar (increasing) functions could be different for the different mass-media – Radio (mainly news emissions – fastest and shortest resonance, sometimes –rear - short analytical notes) (curve No1); TV (also the shortest resonance, a little bit longer time coverage) (curve No 2); newspapers (longer stage) with some

FIGURE 2: THE "SOLIDARITY" FUNCTION

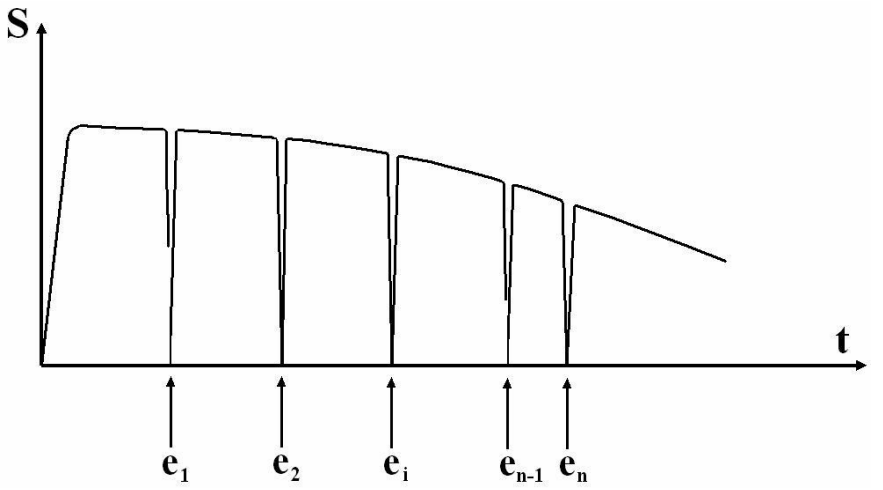
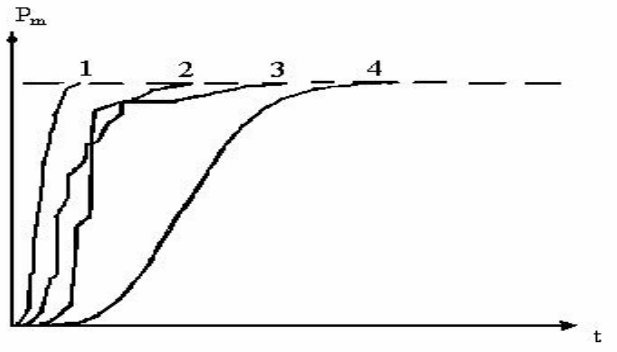


FIGURE 3: THE "MASS-MEDIA" FUNCTION



technological delay (with morning and evening editions) – sometimes analytical articles appear in longer time domain (curve No 3) – but sometimes could be more intensive); Internet – longest stage of reflectance – (curve No 4) with more analysis and opinions, but less primary information. All functions of the mass-media behavior are going earlier or later to "saturation" (dashed line).

The trend analysis shows faster increasing in the initial phase and then slower decrease. The interim events can trigger "bursts" of increasing number of publications, or fluctuations of the function. The functions usually have "maximum maximorum" and significant fluctuations mainly in the decreasing part. This is one of the very few cases, when the functions are relatively easily "measurable". The representative extract could be possible mainly in the country (countries) where the hazardous events have significant consequences.

4.4. The "rumors" function (fig.4)

This is an intensity function, reflecting the generation and spreading of the rumors, which always appear in the society affected by the risk event. Usually this function started with some delay relatively to the initial event. The function is relatively long lasting – weeks to months (even years). The trend (dashed line) faster increases at the beginning and slower decreases. The intermediate events can trigger the "bursts" of rumors, to create plateaus or local maximums (event e_i on the fig.4). If no more events occur, the function goes down always slowly. The function usually has the "maximum maximorum". The collection of data is sometimes possible for this function. Number of different rumors could be collected, but they are not always reliable due to the collection difficulties and the very fast deviations in the content of the rumors.

4.5. The "enthusiasm" function (fig.5)

This is a relatively simple time-intensity function. Describes selected peoples' behavior usually some time after the event. Appears in relatively "better" social conditions, then the other functions, because this is more or less "post event" function. The "enthusiasm" itself appears usually amongst not affected by the hazard event groups of people or in some groups of people affected by the event (most frequently – not strongly), but in both cases among the people willing to help the strongly affected groups of people!

FIGURE 4: THE "RUMORS" FUNCTION

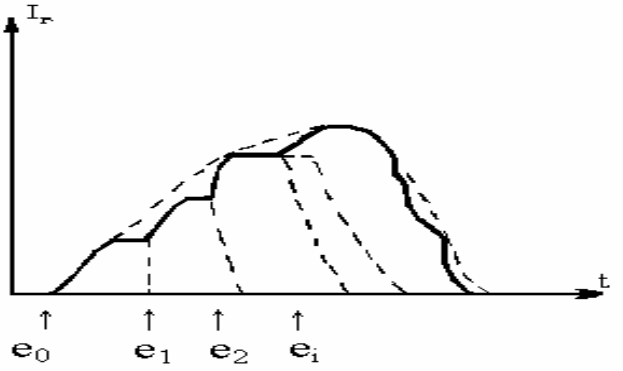
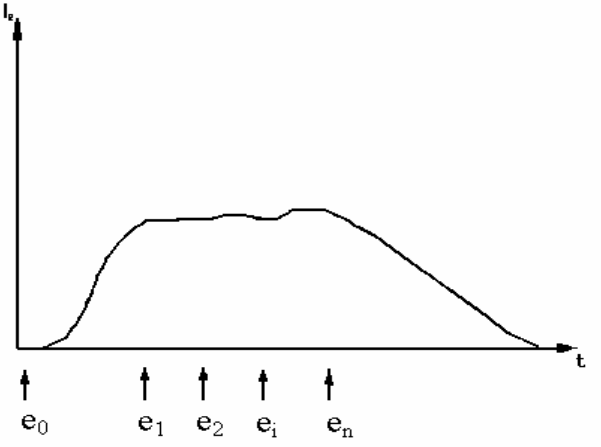


FIGURE 5: THE "ENTHUSIASM" FUNCTION



The function is usually long lasted (months even years) with sharper phase of increase, plateau and slow decrease in time. The function is practically not sensitive to the following events, but some fluctuations could be observed. It makes it possible for some quantitative measurements (for example by the funds or different aids collected).

All functions started immediately after the first event (e_0), only the rumors and the enthusiasm functions could be shifted to later time.

All described above functions have some common properties:

- Strong nonlinearity – this means that (as it can be seen on the figures) exponential and/or logarithmic) behavior of the functions are the most frequent cases.
- Strongly event dependence – this means that each next event more or less affected the group's behavior. This is the normal psychological reaction.
- Strongly affected group's dependence – this means that the "soil is fertilized" by the initial event. This fact also contains the normal psychological reaction.
- The time durations are different, which is supported by many field observations and lessons learnt analysis; sometimes the coincidence of the action of several functions could be expected. This is the most difficult situation for the risk management.
- The bursts of cases are considered, which means, that each case could be described by a separate function.

5. ANALYSIS

For the analysis, the following table was created, summarizing the main properties of the functions. The most important of them are:

- The time duration – it is important to know the average time of the validity of the functions, as they are time dependant. This is an important property for the practical reasons. If in some hypothetical emergency situation there is a mixture of several (or all) functions, the time effectiveness is of a crucial importance for the management practice.
- The sensitivity – it means that the function is strongly sensitive to the next dangerous events. An important property from theoretical and practical point of view.
- Interruptive (or non interruptive) – is an important element, because any kind of analysis and the influence could be implemented during the

"existence" phase of the function. An important property for the mathematical modeling.

- Manageability - a very important property from practical point of view. It gives the level of the possibility to influence the function, using different measures.

TABLE 1: MAIN PROPERTIES OF THE SUGGESTED NON-LINEAR FUNCTIONS (IN AVERAGE)

Function/ Properties	Time duration (min)	Sensitivity of the function	Interruptive	Manageable
PanF	seconds-minutes (10^{-1}-10)	high	yes	yes
SolF	days-weeks (10^{3}-10^{4})	high	yes	yes
MedF	weeks-months (5.10^{4}-10^{5})	low	no	not easy
RumF	weeks-months (5.10^{4} -10^{5})	middle	no	not easy
EntF	months-years (5.10^{4}-5.10^{5})	very low	no	yes

The "sensitivity of the function" means sensitivity to the next following dangerous events with different (but significant) magnitudes.

"Interruptive" – means has (or not) points of interruption.

"Manageable" – means the possibility of management influence.

The "time duration" as average value is given in minutes.

The analysis shows that some difficulties could be expected in several directions:

The main one is the data collection. In such situations to put the interviewers or data collectors using questionnaires, interviews, etc. is

practically impossible. That's why the comparative analysis between the theory verification and the practical realization is a significant difficulty. Always in such cases of the hazards influence the more important activities then the data collection exist (to save the people lives, to protect the affected population, to perform rescue operations, etc.) Afterwards the influence of the event and the people's behavior is forgiven and to reconstruct the people group's behavior is very difficult. That's why the verification of the approach is really difficult. Another difficulty could appear in cases of the multiple risk situations. Most of the factors are acting simultaneously and the exact estimation of the intensity of the functions or their probabilistic behavior is difficult, even sometimes impossible.

6. GENERAL MANAGEMENT MEASURES USING THE FUNCTIONAL ANALYSIS

It is very difficult to take measures for management of the people's social behavior in case of emergency situations, because of the lack of real data. For our approach we use the analogy with the army and/or police groups for emergency actions, because these teams are frequently acting in similar environment:

- Panic function. The practice shows (according to the army, police and emergency teams' trainings) that good training decreases the value of this function.
- The Solidarity (and the values of the respective function). It could be increased among the trained team, due to the exercises in the real environment of similar (as in case of the disaster) conditions.
- The Rumors function is not easy to be managed. The commander's responsibility and the "strong hand" of the commander could decrease (but not fully stop) the values of this function. That's why in the affected regions the organization based on the highest single personal power and responsibility is of a significant importance. All case studies show that if a good organization is created, the number of rumors decreases. One way to influence this function is also to provide widely the relevant information without delay.

- The Media function is hardly difficult to be managed. It is a very difficult task to manage the media response. The media always likes sensations and frequently does not reflect and interpret the available information in the proper way, creating sometimes panic, rumors or other people reflections, which do not help the proper management.
- The Enthusiasm function is the most promising function from the point of view of the management. This is due to the positive circumstances existing in similar environment – people who like to support the affected people, cultural heritage, different structure reconstruction, etc. The response could be managed in long or short time intervals by good motivated and organized persons.

7. CONCLUSION

Several nonlinear functions are presented. They are used as a formal mathematical descriptive element about the groups of people whose behavior is affected by the emergencies of different origins. Their graphical expressions are suggested together with the analysis of the different expected cases. The functions are suggested on the base of the field experience, lessons learnt, case studies and general considerations. The systematic table of the main properties of these functions is created helping the analysis and the practical performance of the functions. Some general management measures are proposed, which could be useful in the everyday management practice or in case of the mathematical modeling of such situations generated by natural hazards, terrorist actions or industrial accidents.

REFERENCES

Blaikie, P., Cannon, T. Davis, I. and Wisner, B (1994). At Risk: natural hazards, people's vulnerability, and disasters, London: Routledge, 213.

Colombo, A. and Vetere Arellano A. (2002). Dissemination of lessons learnt from disasters, NEDIES Workshop, ISPRA, Italy, 63.

ECLAC. (1991). Manual for estimating the socio-economic effects of natural disasters. Santiago, Chile, United Nations, 187.

ISDR. (2002). Living with risk; a global review of disaster reduction initiatives, Geneva, United Nations, pp. 73.

Kovachev, V. Ranguelov, B. & Tsonchev, R. (1997). Risk Management of Natural disasters and catastrophes, NCDE, Sofia, 220.

Munich, Re. (2002). Natural catastrophes in 2002 catalogue.

NEDIES Project Report. Lessons learnt from Earthquakes, EU-JRC, IPSC, Ispra, (2002). 37.

NEDIES Project Report. Lessons learnt from Landslides, EU-JRC, IPSC, Ispra, (2003). 145.

Schwartz, B. (2004). The tyranny of choice, *Scientific American*, No. 4, 43- 47.

Sundnes, K. and Birnbaum, L. (2003). Health disaster management-Guidelines for Evaluation and research in the Utstein Style, *Prehospital and Disaster Medicine,* Vol. 17, No. 3, 343.

The Cyprus Journal of Sciences, Vol. 3, 2005/75-81

MICRO-BIOTA OF SUB-ANTARCTIC SOILS FROM SOUTH-GEORGIA ISLAND

VICTORIA GESHEVA*

ABSTRACT

Microorganism diversity of Sub-Antarctic soils from South-Georgia Island was investigated. It was shown that the soil communities consist of bacteria, fungi, actinomycetes, microalgae. The bacteria were determined as Azotobacter, Cyanobacteria, Sarcina, Rhodococcus, Arthrobacter. Actinomycetes belong to Geodermatophilus. Among the isolated fungi there were representatives of Penicilium, Aspergillus, Cladosporium, Sprotrichum and others. Some of the strains formed extracellular enzymes or produced antibiotics.

Key words: Sub-Antarctic soils, microbial distribution, bacteria, fungi, actinomycetes, enzymes, antibiotics

1. INTRODUCTION

Ecological characteristics of cold climatic regions have interested the scienists many years ago. Investigations on the flora and microfauna of South Georgia Island have included plants (Smith 1988), microalgae (Broady 1979), Collembola (Coney et al. 1999), Protozoa (Smith 1982; Beyens et al. 1995). Data about soil microorganisms is scarce. Thus Bolter (1999) observed microbes as total numbers and biomass. Hurst and Pugh (1982) described some fungi on plants and plant litter.

In this investigation the results of the study of soil microflora of South Georgia Island are presented.

* Institute of Microbiology, Bulgarian Academy of Sciences, Department of Microbial Biosynthesis and Biotechnology, Bulgaria

2. MATERIALS AND METHODS

2.1. Soil samples

The samples were taken from 0-3 cm depth in South Georgia Island near Grytviken, about 100 m above sea by Dr. Schabetberger. They were kindly provided by Dr. W. Petz and described as follows:

Number 1, sandy soil under lichen, pH 4.2.

Number 2, soil under moss, pH 5.3.

2.2. Isolation and enrichment of microorganisms

The samples were treated by the dilution spread method described by Gesheva (2002). Cultivation was carried out at 4ºC, 12ºC and 25ºC. The total number of microorganisms was determined by plate counts and the results were treated statistically.

2.3. Taxonomical grouping of isolates

The bacteria and fungi were isolated on appropriate media listed in Table 1. Their morphological and biochemical characteristics were observed. The determinations were performed according to Bergey's manual and Alexopoulos et al. (1966).

2.4. Assays for antimicrobial and enzyme activities

Determinations were carried out as it was described by Gesheva and Gesheva (2000) as the following test cultures were used: Bacillus subtilis ATCC 6633 and Cladosporium cladosporoides.

TABLE 1: NUMBERS OF MICROORGANISMS IN SOILS OF SOUTH-GEORGIA ISLAND

Medium	25°C Bacteria	x10^4 Fungi	CFU/g 12°C Bacteria	Fungi
Sample No.1				
Meat extract Pepton agar	48±3.5	8.3±1.3	13.9±7.2	5.2±0.7
Czapek agar	38±4.1	11±1.2	8.4±2.1	24±1.7
Kuster agar	12±2.0	14±1.5	9.2±3.1	29±1.5
Mineral agar	39±1.5	12±1.5	4.2±1.3	7.4±1.4
Sample No.2				
Meat extract pepton agar	48±2.5	4.0±0.5	64±5.4	1.6±0.5
Czapek agar	18±2.1	1.6±0.5	40±5.1	3.±2.1
Kuster agar	12±1.2	21±1.5	92±6.3	27±1.2
Mineral agar No.1	20±1.0	4.±0.8	42±2.5	1.9±0.3

3. RESULTS AND DISCUSSION

Microflora of sample No. 1 shows high counts of bacteria growing at 25ºC while this of No. 2 is richer in bacteria at 12ºC. More detailed observations on morphology and biochemical properties of cultures revealed among Gram positive bacteria representatives of Sarcina, Rhodococcus, Arthrobacter. The soil samples No. 1 contains psychrophilic cyanobacteria, Nostoc, Oscillatoria and microalgae. It is not surpising because it is known that terresrial mosses and lichen harbour a wide range of microalgal species. Oscillatoria plays a role in the colonization processes and influences soil structure (Winn-Williams 1987). In sample No. 2 Azotobacter and Geodermatophilus were detected. Line, (1992) studied nitrogen fixation in subantarctic soils and showed that in these regions the denitrification also has a place.

Penicillium and Aspergillus were prevailed in soils of South Georgia Island. Authors who had studied other subantarctic regions also noted the dominance of the both genera listed above (Hurst and Pugh 1982; Kerry 1990; Steiman et al. 1995; Bradner et al. 2000). A great diversity of mesophilic fungi (Table 2) is due to more favourable subantarctic climatic conditions, low pH of the soils and presence of mosses and lichen in them. Bradner et al.(2000) reported for Embellisia sp. associated with moss and Trichoderma sp. found on moss surface. It is known that also plant exudates play a key role for the surviving and development of some genera of microorganisms (Rovira 1965; Whippes and Lynch 1986; Gesheva and Gesheva 2000; Gesheva 2002). Some of the isolated bacteria, fungi and actinomycetes formed extracellular enzymes or biosynthesized antimicrobial agents (Table 3).

Although the microbial populations live in extreme conditions of cold and low nutrient content, they successfully realize their functions and survive. The occurence of several cultures that produce antibiotics or enzymes indicates their biosynthetic potential. Zecchinon et al. (2001) have noted a flexibility of enzymes formed by psychrophilic strains. Russell (2000) assumed that a study of cold active enzymes has a great exploitation importance and may open new horizons in enzymology.

TABLE 2: LIST OF THE FUNGI FROM SOUTH-GEORGIA ISLAND

Taxon	Samples	
	Mesophiles	Psychrophiles
Acremonium butyri	1	
Alternaria alternata	1; 2	
Aspergillus sp.	2	
Blastomyces sp.		1
Cladosporium cladosporiodes		1; 2
Drechslera sp.	2	
Helvella sp.	2	
Fusarium sp.	1	
Mucor mucedo	1; 2	
Penicillium purpurorescens	1	
Penicillium sp.		1; 2

Paecilomyces sp.		2
Russula sp.	2	
Rhizopus sp.		1
Phialospora verrucosa		1
Sporotrichum sp.		1; 2
Ulocladium sp.	2	
Ustilago sp.	1	
Candida sp.		1
Rhodotorula sp.		1
Nonidentified	1; 2	1; 2

TABLE 3: NUMBERS OF STRAINS PRODUCERS OF ANTIBIOTICS AND ENZYMES

Property	Bacteria	Fungi	Actinomycetes
Antibiotic activity against:			
Bacillus subtilis ATCC 6633	11	9	2
Cladosporium cladosporiodes	6	8	1
Enzyme activities:			
□-amylase	20	15	2
protease	15	14	2

REFERENCES

Alexopoulos, C.J, Mim, C.W. and Black-Well, H. (1996). *Introductory mycology*, 4-th ed., John Willey and Sons, New York.

Bergey's manual of sysytematic bacteriology, *Eds. N.R.Krieg, P.H.A. Sheath, J.T.Staley, S.T.Williams, Vol. 1-4, Williams and Wilkins, Baltimore.*

Beyens, L., Chardes, D., Debaero, D. and Verbruggen, C. (1995). The aquatic testacea amoebae fauna of the stromness bay area, South Georgia, *Antarctic Science*, Vol. 7, 3-8.

Bradner, J.K., Sidhu, R.K., Skotnicki, M.L., Selkirk, K.M. and Navaliainen, R. (2000). A new microfungal isolate, Embellisia sp. associated with antarctic moss Bryum argenteum, *Polar Biology*, Vol. 23, 730-732.

Broady, P.A. (1979). Preliminary survey of the terrestrial algae of the Antartctic Peninsula and South Georgia. *British Antarctic Survey Bulletin*, Vol. 48, 47-70.

Bolter, M., Blume, H.P. and Kuhn, D. (1999). Soils and their microbiological properties from a transect Cape Horn to the antarctic peninsula, *Polar Bioscience*, Vol. 12, 54-67.

Coney, P., Greenslade, R., Arnold, J. and Block, W. (1999). Collembola of subantarctic South Georgia, *Polar Biology*, Vol. 22, 1-6.

Gesheva V. and Gesheva R. (2000). Physiological and antagonistic potential of actinomycetes from loquat rhizosphere, Microbiological Research*, Vol. 155, 133-135.*

Gesheva V. (2002). Rhizosphere microflora of some citrus as a source of antagonistic actinomycetes, *European Journal of Soil Biology*, Vol. 38, 85-88.

Hurst, J.L. and Pugh, C.J.F. (1982). Fungi on plants and plant litter in South Georgia, *Colique sur les ecosysytem subantarctiques*, Vol. 51, 249-255.

Kerry, E. (1990). Effects of temperature on growth rates of fungi from subantarctic MacQuarie Island and Casey, Antarctica, *Polar Biology*, Vol. 10, 293-299.

Line, M.A. (1992). Nitrogen fixation in the subantarctic Island, *Polar Biology*, Vol.18, 601-606.

Rovira, A.D. (1965). Interaction between plant roots and soil microorganisms, *Annual Review of Microbiology*, Vol. 19, 241-266.

Russell, N.Y. (2000). Toward a molecular understanding of cold activity of enzymes from psychrophiles*, Extremophiles*, Vol. 4, 83-90.

Smith, M.G. (1982). The terrestrial protozoan fauna of South Georgia, *Polar biology*, Vol. 1, 173-179.

Smith, V.R. (1988). Production and nutrient dynamics of plant communities on a sub-antarctic islands, *Polar Biolgy*, Vol. 8, 255-269.

Steiman, R., Frenot, Y., Sage, L., Seigle-Murandi, F. and Guiraud, P. (1995). Contribution a l'étude de la mycoflore du sol des îles Kerguelen, *Cryptogamie Mycologie*, Vol. 16, 277-291.

Whippes, J.N. and Lynch, L.M. (1986). The influence of the rhizosphere on crop productivity, Advances in Microbial Ecology*, Vol. 9, 187-244.*

Winn-Williams, D.D. (1986). Microbial colonization of antarctic fellfield soils, In: Perspectives in microbial ecology, *Eds. F. Megusar and M. Gantar, Proceedings of IV ISME, Slovene Sociaty of Microbiology, Ljubliana, pp. 191-200.*

Zecchinon, Z., Claverie, P., Collins, T., D"Amigo, S., Delille, D., Feller, G., Georlette, D., Gratia, E., Hoyoux, A., Meuwis, M.A., Sonan, G. and Gerday, C. (2000). Did psychrophilic enzymes really win the chalenge? *Extremophiles*, Vol. 5, 303-311.

The Cyprus Journal of Sciences, Vol. 3, 2005/83-101

NEW QUESTIONS CONCERNING MANAGING DIVERSITY IN SPORT

ANTON ANTHONISSEN[*] and PAUL VERWEEL[**]

ABSTRACT

In the discussion surrounding the management of diversity in sport, various perspectives have been employed that are related to specific ideologies that underpin the thinking on multiculturalism in the broader social context. In the arrangements for dealing with diversity, a number of pitfalls were recognised that result from the reactive approach that tends to dominate the leadership of organised sport in the Netherlands, as it does elsewhere such as in North America. This article argues for a proactive approach in which paradoxical and relational ideas are central since there is some urgency to answer the emerging questions surrounding the management of diversity in sport. We suggest some topics to be explored in future research.

Key words: Diversity, multiculturalism, sport, organization, managerial work

1. INTRODUCTION

Within the context of Dutch society, as in other Western European and North American countries, the arrangements for diversity and multiculturalism have received increasingly demanding attention. The sports sector is no exception. The need and the advisability of organising diversity in sporting activities is regularly addressed (Anthonissen, 2001; Doherty and Chellundurai, 1999; Fink and Pastore, 1999; Fink, Pastore and Riemer, 2001; Knoppers, 2000; Lock, Minarik and Omata, 1999; Mc Daniel and Walls, 1997). However, the daily organisational dynamics in organised sport are characterised by an

[*] Associate Professor of Management and Organization from a Multicultural Perspective, Utrecht School of Governance, University of Utrecht, The Netherlands

[**] Professor of Management and Organization from a Multicultural Perspective, Utrecht School of Governance, University of Utrecht, The Netherlands

equality culture in which there is 'ethnocentrism' and 'paternalism', with hardly any attention given to issues concerning diversity (Fink, Pastore and Riemer, 2001; Knoppers and Anthonissen, 2001). These organisational dynamics within organised sport cannot be considered in isolation since they are related to general social developments.

We start this article with an analysis of the contradictions in the ideologies that underpin the thinking about diversity and multiculturalism. We then use the Dutch sporting context as a starting point to develop these contradictions using international insights. In the analysis that follows, various perspectives in organizing diversity can be distinguished that specifically affect the appreciation of diversity in sport and which, moreover, can set a number of traps. We then argue for a stronger focus on the fragmentation approach to organising (Anthonissen, 2001; Verweel, 2000), and propose a broader approach to managing diversity, in which paradoxical and relational thinking has an important role. This ultimately raises new questions when studying the management diversity in sport.

2. IDEOLOGICAL CONTRADICTIONS

In the Netherlands, various contributions have been made to the analysis of diversity and multiculturalism in the broad social context (De Ruijter, 2001; Schnabel, 2001; Van Praag, 1999; Verweel, 2000). These contributions are sometimes rich in views, sometimes rich in details, sometimes finely balanced, sometimes without any nuances; they may be theoretical but also practical, based on facts or on normative argumentation; but the discussion can be particularly characterised by an interesting contradistinction. Some studies indicate that the Netherlands has long been a diverse and multicultural society (Schnabel, 2001; Van Praag, 1999). One position adopted is that, despite the multiethnic composition of the population, the foundations of cohabitation remain monocultural. Conversely, others argue that the Netherlands has always been a country of migration and, therefore, by definition has had to organise diversity and multiculturalism (De Ruijter, 2001). In the Dutch sport sector, the contributions to the analysis are relatively few in number, but have the same contradictions. On the one hand, emphasis is placed on the monocultural foundations of sport (VWS, 1998). Sport in particular has been ascribed an

integral significance, in which everyone is the same and must ultimately fit in with the dominant pattern of values and standards. On the other hand, diversity in sport is referred to as something that has always been present, albeit infrequently recognised (Anthonissen, 2001, Knoppers, 2001, Elling, 2002).

Ideological bases can be discerned behind the arguments in social scientific sport research and in sport policy initiatives. The monoculturalists and the integration promoters believe that the cultural domination of Western enlightened liberalism – where individual development is the core value – is not only practical, but also desirable (Schnabel, 2001; Van Praag, 1999). In this vision, collective cultures can threaten this liberalism and, due to a lack of individual responsibility, can degenerate into totalitarian systems which are seen as problematic (Sociologists' conference, 1999). For the multiculturalists and the diversity supporters this is an interesting interpretation, but nevertheless primarily a construction of minority interest. They argue that differences have always existed within the historical context of Dutch society such as those based on differences in religion, social class, and social concepts (ideas). The claim is that 'western culture' can be seen as a weapon in the battle for social dominance (De Ruijter, 2001, p.5).

Such views on diversity are not unique in the Netherlands, but can be identified in all complex societies. Due to migration and individualism, multicultural societies have simultaneous sociocultural processes of unity and diversity that affect each other. Various international contributions to the discussion on organising diversity refer to hybridisation and globalisation in this connection (Hannerz, 1992; Latour, 1993). While globalisation and homogenised forces lead to integrative and monocultural trends at various social levels, particularisation, in which diversity is encouraged and heterogeneous forces are stimulated, is discernible. In this way in every society, at the local level, a mixture of uniformity promoting and differentiating forces is created that develops its 'own' dynamics and form.

This claim can be evidenced in various ways within the Dutch sporting world. In discussing integrating 'ethnic minorities', the contributions of Dutch players with backgrounds in the former colonies such as Suriname, the Moluccas, and the Antilles[1] are often referred to with pride. The contributions of Tahamata, Gullit, Rijkaard and recently Kluivert, Davids, and Seedorf are

seen as proof of the accessibility of sport to 'ethnic minorities' and the success of integration based on equality. However, the failures of the Dutch team during the 1996 European Championships held in England, were ascribed to the struggle and divisions between 'black' and 'white' players. There was talk of a 'contested arena' (Hartmann, 2000) in which a marginalised group of football players ('black' Dutchmen with a Surinamese background) and a dominant group ('white' Dutchmen with a Dutch background) were at odds with one another over their preferences for a playing style. Thus, the integration does not appear to have been very advanced, and the black players were condemned for their self-chosen isolation and their claims over the black contribution to the football successes.

The same trends are visible in amateur football. While everywhere, sport is seen as the place where integration can take place (while it may be more difficult in labour organisations) due to the accessibility and the enthusiasm for football of boys with Dutch-Moroccan and Dutch-Turkish backgrounds[2], their participation in local clubs appears to be clearly lower than for boys with native Dutch, Dutch-Surinamese, or Dutch-Antillean backgrounds (Elling, 2002; Janssens, 1999). Meetings between 'ethnic minority' clubs and traditionally white 'native Dutch' clubs, are typified as playing internationals which while you may lose to other teams, have to be won[3]. Etiquette is vulgarised, fighting increases, and matches are regularly abandoned due to disturbances (Janssens, 1999). Clubs in various branches of sport report that they have trouble handling 'ethnic minority' youth (i.e. boys) because their parents do not participate enough as volunteers, and the behaviour of the 'ethnic minority' boys is seen as problematic (Anthonissen and Van Eekeren, 2000). 'Explanations are particularly placed with ethnic minorities, while there is less focus on the dominant conceptualisation and constructions of interpretation by the ethnic majority' (Elling, 2002, p.95). While the struggle between the boys is clearly visible, it is different among girls and women, and in their relationship with the opposite sex. Coloured girls and women with a foreign background participate less in organised forms of sport due to religious considerations[4]. Although there is a policy line in sport in which 'ethnic minority' clubs are seen as part of the integration process along with 'native Dutch' clubs (Janssens, 1999, Lagendijk and Van der Gugten, 1996) many native Dutch people see clubs exclusively comprised of ethnic minorities as undesirable.

3. DIFFERENT PERSPECTIVES

Three perspectives on organising culture and diversity are frequently distinguished in society and organisational sciences: the integration approach, the differentiation approach, and the fragmentation approach (Martin, 1992; 2000). In the integration approach, society and its organisations are seen as a univocal system. This system has a central leadership, general values and norms, harmonious relationships, and hierarchical central values. This approach dominates in organising diversity. In the sport sector, this can be found in the unilateral thinking about achievement and competition, and the importance that is ascribed to the pyramid structure (Anthonissen, 2001). The pursuit of harmony and the continued survival of these core values lead to disciplining and standardising divergent ideas, and thereby to a culture of uniformity (Doherty and Chellundurai, 1999). Where the adjustment to the norms does not take place by itself, or takes place through coercion, undesirable spheres of deviation and subcultures may be created (Duyvendak, 2001; Siebers, 2002). For obvious reasons, this approach is often under attack in the debate on diversity and multiculturalism. It is important to distinguish between the more theoretical viewpoint and the pragmatic viewpoint since it appears that the argument for integration goes hand in hand with the preservation of the affiliative character (preserving one's own culture and beliefs) of the 'native Dutch' and 'ethnic minority'' groups.

In the pragmatic approach, participation in the socioeconomic traffic is the objective of integration as is to a lesser degree the integration of private life. There is also an area of tension since the preservation of cultural individuality may lead to formal and informal exclusion, which make socioeconomic integration all the more difficult.

For the most part, the wider thinking on diversity reflects the differentiation approach. In this approach, society and the organisations are seen as the summation of various group interests and perceptions (Siebers et al., 2002). The coherence in society and in its organisations consists of the, albeit temporary, balance based on the conflicts of interest that exist between groups. Groups live by their own (sub) cultural convictions and interests and also operate as groups. It is an approach that clearly exists among groups of sportsmen with similar backgrounds who organise themselves into separate

sports organisations to feel more at home (Anthonissen and van Eekeren, 2000). Supporters of the differentiation approach often point to the importance of group individuality (Pinto, 1994, Derveld, 1995). The designation of categorised (read marginalised) groups, as developed in the integration approach, is adopted but detailed in a positive way. In this way however the struggle for recognition of the differentiation is more a response to unsuccessful integration than a consciously chosen approach. Cultural differences between groups are recognised and presented as explanations for problems in communication, organisational processes, and social developments. Within this approach, however, it remains unclear – both on normative and empirical grounds – whether integration or an enduring differentiation will be the ultimate result.

The fragmentation viewpoint is enjoying increasing support (van Bekkum and Bernet, 2001). The individual is the starting point of analysis in this somewhat postmodernistic view. Individuals have various social features that may play a role or be deployed in changing moments and in changing configurations (Acker, 2000). Individuals can continually choose to change groups and frameworks of thinking to give purpose and meaning to their deeds. Behaviour and identity cannot be directly converted into a single dominant classification criterion, and people can assign and retract their loyalty (van Bekkum and Bernet, 2001). In the fragmentation viewpoint, both the social trend toward individualisation – in the sense that a person is no longer captive in a univocal social and cultural position – and the scientific trend towards interpreting society from multiple simultaneous social and cultural positions and orientations can be distinguished (Lindo, 1996; Shahid, 1998; Siebers et al., 2002; Mc Daniel and Walls, 1997). On the one hand, this involves an individualised approach to group cultures (Shahid, 1998). On the other hand, the individualistic position - that the influence of group cultures is an important frame of reference - is not refuted (Siebers et al., 2002). A criticism of this approach is that one's individual freedom to choose is more a theoretical than an empirical reality. A normative objection is that this position can lead to the perception of a calculating individual and a lack of social solidarity.

With these three perspectives, what matters is whether the relationships in sport and society are perceived in the light of: (1) the idea that differences are temporary because the 'newcomers' – after one or two generation(s) if need be

– and other 'others' adjust; (2) diversity is a matter of identity in one's own circle, which is shaped through ethnic and cultural differences, and the task lies in acquiring a better understanding of one another through dialogue or by removing the structural subordination of newcomers through participation; or (3) differences are always present, but temporary and hypothetical through the categorisation of groups. It is not ethnicity and culture but, ultimately, the opportunity for individuals to participate and their choices of identity that are of decisive importance. For a very long time in Dutch society and in the sports sector, the emphasis in the discussions on diversity was placed on the first two options, and culture was very easily added as an explanation for all sorts of problems in human interaction. However, this approach implies the danger of '*culturalisation*'; in other words, the attribution of actions and ideology of groups and individuals to unilateral and univocal cultural factors (Duyvendak and Veldboer, 2001; Shahid, 1998; Verweel, 2000). The idea is increasingly developing that the unilateral use of culture as an explanatory factor leads to cultural determinism and, moreover, creates an explanation for the lack of evaluative power with respect to individual differences between people (Grundemann, 1999).

4. THE MORAL DIMENSION

The adherents of diversity and multiculturalism in Dutch sport, and also elsewhere such as in North America, usually accept the proposition that differences are good, nice, and useful. "It involves increasing the consciousness and appreciation of differences associated with heritage, characteristics and values of different groups. It also involves developing an appreciation of those differences as well as respecting the uniqueness of each individual" (DeSensi 1995, p.35). The criticism of diversity as richness is however more of an ideological viewpoint than an empirical reality. It was implied earlier that the rule that differences are good is disproved by the reality in which differences lead to problems. The claim that a society or sports organisation improves its chances of survival by increasing its diversity is also only an assumption for which there is little empirical evidence (Verweel, 2001). Overall, it appears that the management in Dutch sports organisations hardly look into the possibilities of diversity being a basic assumption for organisation (Anthonissen and Boessenkool, 1998). There is no difference in

the North American context (Fink and Pastore, 1999; Doherty and Chellundurai, 1999; Doherty and Carron, 2003). Until now, Dutch sport organisations have tended to have problems with the differences – of whatever sociocultural nature – rather than to be able to turn them into an advantage. Deploying people's ethnic characteristics for targeting group policy and ethno-marketing in organisations, may limit their ability to develop as members just as much as looking back to their old ascribed group identities.

We assume that differences between people are inherently neither right nor wrong. Differences are inevitable because people always make distinctions and set their own norms (De Ruijter, 2001). People give meaning to situations by interpreting them in terms of differences and similarities. The coordination of differences assumes receptivity, use, and curiosity, but also openness in one's own culture and the social opportunities to give diversity a place (Krikke et al., 2000). In addition to the primary basic assumption that differences are inevitable, it is seen as a moral and social responsibility that management and other members of an organisation handle people fairly (Anthonissen, 2000; Doherty and Chellundurai, 1999; Verweel 2001). This means that the way in which 'difference' acquires meaning, and how it is dealt with, is not a value-free activity. Nevertheless, many people involved in sports practice, as well as sports theorists, see 'making a difference' as a value-free activity, in which no, or hardly any, direct relationship is seen with ideologies that are related to social relationships and structures such as ethnicity, race and religion, gender, and sexual preference. Most of the ideas and images about organisations and the recommendations that are given to them are also based on a value-free supposition about the functioning of organisations. These formulations of the theory and the practice treat everyone as equals, despite the differences in gender, ethnicity, race and religion, sexual preference, etc. (Knoppers, 2000).

As indicated, making a distinction involves the characterisation of people and human societies, and is based from the outset on the establishment and standardisation of differences. The influences of migration, globalisation, and localisation have given the identification of differences in the Netherlands an extra incentive in recent years. The concern is who is in a position to be able to recognise the differences. Fink, Pastore and Riemer (2001) indicate that personal experience and personal contact with people who 'are different from you' contribute to an orientation towards diversity. In organised sport, such

experience and willingness remains barely visible. Weick (1995) argues that individuals give interpretations based on connecting frameworks of thought to concrete experiences. These frameworks of thought include social, organisational, interpersonal, and individual aspects. The dominant frameworks of thought within organised sport are linked to the achievement norm and the physical possibilities of white heterosexual men (Knoppers and Anthonissen, 2001). When the considerations and research into the organisation of diversity in sport are analysed, it is striking that organisational and interpersonal aspects are unilaterally explained in the way they relate to the dominant group, or its members; and there is little room for any individual significance of people who in some aspect 'are different' (Verweel, 2001).

5. PITFALLS IN ORGANISING DIVERSITY

When the importance of the individual coupled with the fragmentation perspective on organising sports activities becomes more of the focal point, the thinking on diversity can no longer have its central focus merely on ethnic-cultural differences, or be considered as a value-free activity. Although one sometimes makes distinctions in terms of religion and nationality within such an approach, the basis of the diversity, in this point of view, lies in people's ethnic-cultural characters. A narrow definition of diversity is used, in which people are classified into specific categories based on one social feature. This provides a unilateral image of an individual's development of identity, and influences the social structures in the organising processes. This is the reason why some point to the use of a broader definition of diversity, in which not only primary dimensions such as gender, ethnicity, race, religion, sexual preference and age, but also secondary dimensions such as place of residence, work experience, work style, mother tongue, seniority, and position in the organisation are distinguished and related to each other in the changing configurations (Van Dijk, 2001; Loden, 1996). However for some individuals, the use of a broad definition, which does not give close attention to a specific social feature, can mean that a dominant principle of identification is not taken seriously. This rightly or wrongly, may create a feeling of discrimination. In specific situations, if the meaning and consequences of integration and differential thinking are not linked to the meanings and consequences that arise

from fragmentation thinking, a number of pitfalls can be identified in organising diversity.

Firstly, the dominance of the integration and differentiation approach in organised sports is tainted by neutrality in thinking about differences, and a lack of reflection on the effect of one's own perspective on another. The non-recognition and lack of reflection on this allegedly value-free position is connected to the expressions of traditional masculinity by white men who are usually in positions of power in sport in the Netherlands and elsewhere (Knoppers, 2000; Knoppers and Anthonissen, 2001). White men in particular seem to define their masculine identity and masculinity in terms of what 'it is not', such as everything that can be associated with femininity and ethnic/racial differences (Wade, 2001). As a result, 'the other' is taken as a reference point. "When we are talking about diversity, we are talking about the other, whatever that might be, someone of different gender, race, class, national origin: somebody at a greater or lesser distance from the norm: someone outside the set, someone who possesses characteristics, features or attributes……someone who does not fit into mental configurations that give our lives order and meaning" (Madrid, 1993:385). This exclusive talk about the image and the behaviour of "the other", without reflecting on one's own perspective through which 'the other' is examined or approached, is a major pitfall in the thinking about the associations with diversity (Anthonissen and Verweel, 2001; Lock, Minarik and Omata, 1999; Verweel, 2001).

A second danger lies in considering all the possible relevant differences, within the broad concept of diversity and its organisation, to such an extent that discriminatory practices are not quickly recognised. In this situation, diversity quickly acquires a superficial expression (Prasad, 1997) in which the focus on diversity is used by the dominant group as an excuse for not devoting attention to the underlying power factors that exist in their organisational ways, or for not putting effort into giving meaning to individuals and groups. A third trap regards the one-sided talk about categories of difference (target groups). Minority group members become assessed not on their individual but on their group features (Kanter, 1977). In this way, individuals are assigned the overall definition of the group, based on some distinguishing aspect. They are then the symbolic representatives ('tokens') of a group and 'they unintentionally and unconsciously reinforce the 'we' feeling in the dominant group because they

reinforce a significant similarity in that dominant group ('being white' or 'being male')' (Siebers et al., 2002, p. 135).To a dominant group, the outcome is that they interpret diversity as existing only for subdominant or marginalised groups and individuals.

A fourth pitfall is related to the centralisation of individual interpretations in organising diversity. The failure of people to achieve, to become eligible for a position, or to obtain recognition from others becomes defined as the 'personal responsibility' of the individual involved. The influences linked to internal relationships and the division of positions within the dynamics and context of organising are forgotten. Men with a foreign background and women continue to be strongly under-represented in positions with decision-making power. Acker (2000) has shown that organisational processes are strongly tinged by social relationships that are connected with differences in ethnicity, gender, class, etc. She therefore argues for looking not only at individual differences in constructions of meaning, but also for considering the inequality of power in the organisational dynamics as expressed in the construction of discourses about dominant images of the organisation, about principles of labour division and other ways of structuring, and about interactions between individuals who provide the processes of inclusiveness and exclusion.

Managers with the tendency to take action reactively are more rapidly confronted with these pitfalls. Anthonissen and Boessenkool (1998) have shown that a large percentage of the managers in Dutch sport organisations display reactive behaviour and have a perspective on organising diversity that is primarily focused on integrating the differences. This is in contrast to the North American context where, within intercollegiate athletic organisations, management behaviour is less reactive in nature, and more focused on compliance. This appears to be connected with the more stringent supervision of compliance with the statutory legislation in the field of discrimination. 'Usually this type of strategy is utilized to avoid costly legislation associated as a liability rather than an asset, they make no attempt to accommodate those differences or make them feel valued …' (Fink, Pastore and Riemer 2001, p. 17). In the Dutch sport sector, managerial behaviour appears to be less related to statutory legislation and more related to the limited time that an organisation can invest in this type of voluntary form of organisation (Anthonissen and

Boessenkool, 1998). However, the significance of differences in the organisation of diversity for all organisation members is not well thought through (Glastra, 2002).

6. NEW APPROACH: PARADOXICAL AND RELATIONAL THINKING

Despite all the above possibilities, organising diversity in sport in the Dutch context is dominated by thinking in terms of integration and equality. There is no difference in the North American context or indeed, for example, within the Caribbean context (Marcha and Verweel, 2000). In these varying contexts, people have to adjust to the dominant culture. Everywhere we find adherents of the differentiation approach who claim that categorising people creates space for differences between groups (but integration within one's own circle is neglected) and claim that differences are both good and fruitful. The fragmentation approach (within a critical approach to the influence of social structures on the significance of individuals and groups) receives little attention and often only if the dominant group is not challenged.

We believe that an eclectic approach is required, albeit one based on a theoretical perspective of paradoxical thinking about organising diversity. We admit that we can recognise such perspectives and practices both in theory and in practice, but often with paradoxical consequences. We recognise the adjustment efforts in society and sport for 'newcomers', but we see the enormous emphasis on integration leading to the exclusion of people who think differently, thereby actually creating emphatic differences. On the one hand, we can see that the differentiation approach to culture leads to clarity and participation for one's own group but on the other, group and individual differences in one's own circle are neglected, so that the integration approach is enforced within one's own circle. Where fragmentation is permitted, based on the construction of new interpretations, it appears possible to achieve new forms of integration that surpass old ethnic, gender, class, sexual and age differences.

Those who take the power of internationalisation and localisation, as well as the power of individualism and socialisation, seriously in organising diversity cannot logically continue to place trust in the integrationist approach

alone since, here, the fundamental attitude is: 'the other may be different provided he/she answers to the dominant image of the dominant groups'. Moreover, this approach does not appear able to provide an empirical description of the 'individuality' of the dominant group (the national values) which appears logical, given the complex history of each country, each branch of sport, and each organisation. Anyone who has practical knowledge of multicultural coexistence and organisation based on social relationships such as ethnicity/religion, gender, class, sexual preference and validity, can hardly contend that the differences are only beneficial and provide synergy. Moreover, the approach repudiates the individualisation process and endeavours to foster forced group images from the past. The fragmentation approach also demands relational thinking, in which one wishes to, and can relate to, the other in organisational processes. This applies within relationships between individuals, in which the other is recognised by one's own values and norms, and particularly for their attitude and behaviour, and vice versa. Similarly, at the group level, the values, norms, attitudes, and behaviours of another group are also related to the values, norms, attitudes, and behaviour of the group to which you belong (Anthonissen, 2000, Siebers et al., 2002).

As Fink and Pastore (1999), we assume that proactive attitudes and behaviour contribute more to organising diversity than does a reactive attitude or an attitude that is characterised by compliance. We have also experienced that, in the sport sector, proactive attitudes and behaviour among managers and coaches only develop incidentally. However, as we see it, a proactive attitude and corresponding behaviour by a manager is unlikely to have positive consequences in the short term in terms of organisation. Organising diversity is a social activity that shows results only over long periods of time (Glastra, 2002). In the present broad social context, efficiency, instruments, and results have the upper hand in the short term. The sport sector is also influenced by these developments, making the organisation of diversity in sport a more complicated matter. Nevertheless, managers who do display proactive attitudes and behaviour can be found in Dutch sport. They reflect that, first of all, reflecting on one's own image and one's perspectives of 'others' is normal in a proactive attitude, so that the other can be understood for his or her own significance (Anthonissen and Boessenkool, 1998). Secondly, it is normal in a proactive operating procedure that presuppositions are also turned into thinking about diversity. If it is assumed that fragmentation leads to a loss of social

cohesion, then one should investigate whether fragmentation does not also create demands on other forms of cohesion (Verweel, 2001). Thirdly, a proactive approach focuses on the influences of a range of social relationships in organising sporting activities. Attention is given to the meaning of the process by which sport is organised - and the power question: who, in what position, can impose divisional principles on others and will this take place fairly?

7. CONCLUSION

We have tried to provide insights into the various views on, and contributions to, organizing diversity in sport. We have also indicated our normative viewpoints with respect to organizing diversity in which paradoxical and relational thinking is connected with the fragmentation perspective on organisation. This has consequences for the questions that are raised, and that could be investigated, from this perspective in research. Thus, the question is how could those in the organised sports sector use an eclectic approach, in which paradoxical and relational thinking is the focus, in their contribution to the organisation of diversity? Are there opportunities and impediments that can be distinguished in this? How for example can the fragmentation approach to the organisation of diversity contribute to a bond between individuals and groups within sport? Do experiences in organising diversity in sport contribute to attitudes and behaviour outside sport and vice versa?

The question remains as to whether, and in what way, managers and others involved in the current context will attempt to give organising diversity in sport a more proactive form? How will managers deal with the tension between the pursuit of integration in the short term, and the long-term results in the field of diversity? How will specific social relationships in organising diversity in changing situations effect individuals (and groups), and how will this be expressed in the experiences of those involved in various positions in organised sport? Finally, how do images of white heterosexual masculinity contribute to the preservation of the dominant culture and the reactive behaviour in managing diversity within Dutch organised sport?

NOTES

1. The use of the term 'ethnic minority': white Dutch people are native Dutch. Blacks are a heterogeneous group coming from areas such as Suriname and the Antilles. The Government regards people of colour who come from other countries (excluding Europe and North America) as foreigners, even if they are born in the Netherlands or hold Dutch citizenship).
2. The use of the term race/ethnicity is complex and problematic. Therefore, we use hyphenated forms such as Dutch-Moroccan and Dutch-Turkish.

3. Dutch sport is organised in clubs at the local level, and associations at the national level. The Dutch government has long propagated a two-track policy. While native Dutch sports organisations must be made more accessible to 'ethnic minorities', organisational structures for ethnic minorities have also been created. This policy is up for discussion in 2004.

4. Participation rates in organised sport (Hover, 2002) [The author has viewed these rates for the mentioned groups only. There are no interrelations between the groups]:

Native Dutch	m	39%
	f	34%
Dutch-Turkish/	m	29%
Dutch-Moroccan	f	9%
Dutch-Surinamese/	m	35%
Dutch-Antillean	f	23%
Dutch-Moluccan	m	36%
	f	33%
Others	m	33%
	f	22%

REFERENCES

Acker, J. (2000). Revisited class: Thinking from gender, race and Organisations, *Social Politics, Summer*, 192-214.

Anthonissen, A. (2001). Dutch sport organisations in transition: Organising diversity, In J. Steenbergen, P. de Knop & A. Elling (Eds.). *Values and Norms in Sport* (197-216), Oxford: Meyer and Meyer.

Anthonissen, A. and Boessenkool, J. (1998). *Betekenissen van besturen: Variaties in bestuurlijk handelen in amateur sport organisaties* [Meanings of management; Diversity of managerial performance in amateur sport organisations], Utrecht: Isor.

Anthonissen, A. and Eekeren, F. van (2000). *Interculturalisatie: nieuwe kansen in de sport* [Interculturalism: New Possibilities in Sport], Utrecht, The Netherlands: The city of Utrecht.

Bekkum, D. and Bernet, T. (2001). Werken met loyaliteiten in multiculturele teams (Working with loyalties in multicultural teams], In D. Bekkum & T. Bernet, *Multiculturele ontwikkeling in arbeidsorganisaties. Werken met Verschillen* [Multicultural developments in workorganisations], Utrecht: Forum.

Derveld, F.E.R. (1995). *Intercultureel Management in Perspectief* [Intercultural management in perspective], Groningen: SIV.

DeSensi, J.T. (1995). Understanding multiculturalism and valuing diversity: A theoretical perspective, *Quest,* Vol. 47, 34-43.

Doherty, A.J. and Carron, A.V. (2003). Cohesion in volunteer sport executive committees, *Journal of Sport Management,* Vol. 17, 116-141.

Doherty, A.J. and Chellundurai, P. (1999). Managing cultural diversity in sport organisations: A theoretical perspective, *Journal of Sport Management*, Vol. 13, 280-297.

Dijk, R. van (2001). Persoonlijke barrière belemmert vaak ontmoeting met allochtonen [Personal barriers restrict meetings with inorities], 'Between cultures', *Mediator, September* 2001.

Duyvendak, J.W. and Veldboer, L. (Eds) (2001). Meeting point Nederland [Meeting point The Netherlands], Amsterdam: Boom.

Elling A. (2002), *Ze zijn er niet voor gebouwd. In en uitsluiting in de sport naar sekse en etniciteit* [They are'nt build for it. Inclusion and exclusion in sport by gender and ethnicity], Nieuwegein: Arko.

Fink, J.S. and Pastore, D.L. (1999). Diversity in sport? Utilizing the business literature to devise a comprehensive framework of diversity initiatives, *Quest,* Vol. 51, 310-327.

Fink, J.S., Pastore, D. and Riemer, H.A. (2001). Do differences make a difference? Managing diversity in division IA intercollegeate Athletics, *Journal of Sport Management,* Vol. 15, 10-50.

Glastra, F. (2001). Diversiteitsmanagement in Nederland [Diversitymanagement in the Netherlands], In Forum (Eds.) Het leven en de leer [Life and theory] (9-34), Deventer: Salland de Lange.

Grundemann, A. (1999). 'Different' yet normal. Blacks, migrants and refugee girls in the care services. In *Multicultural development in labour organisations* (42-44), Utrecht: Forum.

Hannerz, U. (1992). *Cultural complexity: Studies in the social organisation of meaning*. New York: Columbia University Press.

Hartmann, D. (2000). Rethinking the relationships between sport and race in American culture: Golden ghetto's and contested terrain, *Sociology of Sport Journal,* Vol. 17, 229-252.

Hover, P. (2002). *Sport in cijfers 1978-2000* [Sport in figures 1978-2000], Arnhem: NOC*NSF.

Janssens, J. (1999). *Etnische tweedeling in de sport* [Ethnic division in sport], Den Bosch: Diopter-Janssens Van Bottenburg.

Kanter, R.M. (1977). *Men and women of the corporation*, New York: Basic Books.

Knoppers, A. (Ed.) (2000). *The construction of meaning in sport organisations: Management of diversity*, Maastricht: Shaker.

Knoppers, A. and Anthonissen, A. (2001). Meanings given to performance in Dutch sport organisations: Gender and racial/ethnic subtexts, *Sociology of Sport Journal,* Vol. 18, 302-316.

Krikke, H. (Ed.) (2000). *Hand in eigen boezem. Vijftien jaar pionieren in de multiculturele samenleving* [Examining your own conscience. Fifteen years of pioneering in a multicultural society], Heeswijk: Dabar-Luyten.

Lagendijk, E. and Gugten, M. van der (1996). *Sport en allochtonen* [Sport and immigrants], Rijswijk: Ministerie van VWS.

Latour, B. (1994). *Wij zijn nooit modern geweest. Pleidooi voor een symmetrische antropologie* [We have never been modern. Plea for a symmetric anthropology], Rotterdam: Van Gennep.

Lindo, F. (1996). *Maakt cultuur verschil?* [Makes culture a difference?], Amsterdam: Het Spinhuis.

Lock, R.S., Minarik, L.T. and Omata, J. (1999). Gender and the problem of diversity: Action research in physical education, *Quest,* Vol. 51, 393-407.

Loden, M. (1995). *Implementing diversity*, Chicago: IRWIN.

Madrid, A. (1993). Diversity and its discontents. In V. Cyrus (Ed.), *Experiencing race, class and gender in the United States*, Mountain view CA.

Marcha, V. and Verweel, P. (1996). *Management of diversity in Antillean organisations*, University of Utrecht: ISOR.

Martin. J. (1992). *Cultures in organisations: Three perspectives*, New York/Oxford: Oxford University Press.

Martin, J. (2000). *Organisational culture, Mapping the terrain*, London: Sage.

Mc Daniel, R.R. and Walls, M.E. (1997). Diversity in the workplace, *Journal of Management Inquiry,* Vol. 6, 363-376.

Pinto, D. (1994). *Interculturele communicatie* [Intercultural communication), Houten/Diegem: Bohn Stafleu Van Loghum.

Praag, C. van (1999). *Tussen loos gebaar en zelfverloochening: theorie en praktijk van het multiculturalisme*. In Voorjaarsconferentie De waan van de dag. [Between an empty gesture and self-denial: multiculturalism in theory and practice], Spring Conference The delusions of the day, Utrecht 23 April.

Prasad, P. (Ed.). (1997). *Managing the organisational melting pot. Dilemmas of workplace diversity*, London: Sage.

Ruijter, A. (2001). *De multiculturele arena* (The multicultural arena], Tilburg: UVT Oratie.

Schnabel, P. (2001). *Diversiteit mag niet leiden tot gezondheidsverschillen*. [Diversity may not result in health Differences], ZonMW-Special 'between cultures'. Mediator 2001.

Shahid, W.A. (1998). *Grondslagen van interculturele communicatie. Studieveld en werkterrein*, [The Foundation of intercultural communication. Field of study and working area], Houten/Diegem: Bohn Stafleu Van Loghum.

Siebers, H., Verweel, P. and Ruijter, A.de (2002). *Management van diversiteit in arbeidsorganisaties* [Management of diversity in work organisations], Utrecht: Lemma.

Verweel, P. (2000*). Betekenisgeving in organisatiestudies. De mechanisering van het sociale*. [Meaning in organisational studies: Mechanisation of the social], Utrecht The Netherlands: ISOR oration.

Verweel, P. (2001). *Bewogen Gewogen: beschouwingen over multiculturalisme*. [Moved weight: views of multiculturalism]. In Forum, Het leven en de leer [Life and theory] (35-42), Deventer: Salland de Lange.

Verweel, P. and Anthonissen, A. (2000). Color blinds: Constructing ethnic identity in sport organisations. In A. Knoppers (Ed.). *The construction of meaning in sport organisations: Management of diversity* (91-102), Maastricht: Shaker.

VWS (1996). *Wat sport beweegt* [What sport moves]. s' Gravenhage: SDU.

The Cyprus Journal of Sciences, Vol. 3, 2005/103-114

CAN A COMPANY'S PRESENCE IN THE NET INFLUENCE THE PURCHASING BEHAVIOUR OF THE CONSUMER IN THE PHYSICAL STORE?

CONSTANTINOS-VASILIOS PRIPORAS* and
NIKOLAOS KARATZOLAS**

ABSTRACT

The development of Internet activities has changed the way that companies operate as well as the purchasing behaviour of consumers. This paper presents an exploratory study aiming to investigate the influence of a company's presence on the Internet in the behaviour of consumers in the natural shop. A field research with a sample of 350 active Internet users residing in Thessaloniki and Athens was realized. The paper provides an analysis of the data, a discussion of the findings and finally, offers direction for future research.

Key Words: Consumer Behaviour, e-Business, on-line Marketing, Internet, Greece

1. INTRODUCTION

Undoubtedly, the rapid growth of the information technology and particularly the explosion of commercial activities on the Internet (B2C, B2B), had a significant impact on the way that enterprises contact their businesses as well as on buyer behaviour. The Internet has created a whole new marketplace (Jayawardhena et al., 2003), which according to Kotler et al, (2002) is hypercompetitive. The digital economy offers a wide spectrum of opportunities and advantages for enterprises (Kau et al, 2003; Porter, 2001; Saunders, 2000); especially in countries with well developed infrastructure for marketing activities over the Internet (Kau et al, 2003) and as a result a plethora of

* Head of Postgraduate Studies, Athens Graduate School of Management, Thessaloniki Campus, Greece
** MBA Graduate, Nottingham Trent University, UK

companies all over the world offer the consumers the alternative convenience of e-shopping.

E-consumer behaviour is attracting marketing domain and over the past few years a considerable volume of research work has focused on its various aspects such as purchase (Vijayasarathy, 2003; Stafford and Stern, 2002; Koufaris, 2002; Ba and Pavlou, 2002), web site use (Ranganathan and Ganapathy, 2002; Goldsmith and Laffarty, 2002, Palmer, 2002), e-consumer profiling and segmentation (Jayawardhena et al., 2003; Saaed et al. 2003, Mathwick, 2002), satisfaction (Shankar et al., 2003; Otto et al., 2000). Further other research studies indicate that there may be a systematic difference in buyer's behaviour for products and services chosen online as opposed to physical market. For example, price sensitivity may actually be lower online than offline (Degeratu et al., 2000; Lynch and Ariely, 2000) and also, brand names could also have a higher impact online than offline (Degeratu et al., 2000).

As in Greece the e-commerce is in its early stages of development, however, with growing rates (Priporas, 2003; Vrechopoulos et al., 2001; Kardaras and Papathanasiou, 2000), an attempt has been made in the present study to investigate if a company's presence in the Internet influences the buying behaviour of a consumer in the physical store. The structure of the paper is as follows. The next part develops the theme of e-consumer and associated issues. The third part describes the research methodology followed by the presentation of the empirical results. The final part provides concluding comments along with some limitations and suggestions for further research.

2. LITERATURE REVIEW

Consumers are entering a new era in which the majority of value adding activities in the economy will move to the digital economy (Georgiades et al, 2000), where the technologies redefine the way that they interact with producers and retailers (Burke, 2002). As a result, the number of Internet users is increasing with rapid growth. Everyday thousands of new users in the World are connected and thus, the Internet continuously gains more attention from the consumers in comparison to television, newspapers and periodical press (Nie

and Erbring, 2000). In the near future Internet users will undertake numerically those that "have still not discovered" the world of Internet (Kotler and Armstrong, 2001).

The Internet is deeply changing consumer behavior. Today, customers walk into stores armed with information about the products that they have found in the Internet. It is characteristic that one in five walking into a Sears store in the USA to buy electrical appliances has researched their purchase online. Half of the 60 million of consumers in Europe who are connected to the Internet have purchased products offline after having investigated prices and details online according to a study by Forrester (The Economist, 2004). Kotler et al, (2002) argue that consumers are very knowledgeable in comparison to the past, since they are more aware of competitive offers, more price conscious, more demanding and thus, power is shifting from the producers and retailers to the consumers (Kotler et al., 2002; Moynagh and Worsley, 2002).

People are now buying many types of goods and services on the Internet. Shankar et al., (2003) point out that the regular online customers can compare alternatives more easily than offline customers, especially when it comes to functional products and services. The reality is that every customer today is inundated with thousands of products and service offers. However, every customer has a limited cognitive and financial capacity, and hence customers are concerned about their own needs and how to fulfill them. On the other hand, marketers, in order to identify consumer's needs, must understand their choice perspective (i.e., what the customer thinks, wants, desires, etc) and also to observe who the customers admire, who they interact with, and who influences them (Kotler et al, 2002).

Internet consumers differ from the traditional ones regarding the buying process. They have bigger control over the marketing process since they mainly control the interaction in online marketing (Kotler and Armstrong, 2001). The knowledge of consumer behaviour is essential for the enterprises' success. The soul of this new consumer, the e-consumer, is a labyrinth of sentiments, preferences, behaviors, distresses and devotion. This new consumer is confused, shows confidence and simultaneously mistrust, busy but also curious, anonymous and unique (Sultan and Henrichs, 2000). The reality therefore, is that the behaviour of this new consumer changes in fundamental

sectors, but not absolutely. The new technologies and mainly the Internet have changed the way that the consumer behaves both online and offline. At the same time however, s/he has maintained certain characteristics and needs of the traditional consumer (Wind et al., 2002). For example, a consumer can sometimes buy from a virtual shop, another through mail order and another via Internet. Also, one day they can buy from a virtual shop with offers in various products and the other from an online auction, depending on their mood.

The motives of human activities remain the same as the Internet offers new ways of satisfaction. The consumer has still the same human needs for interaction, individualisation and convenience during their purchases. The consumer selects and keeps from the Internet technology what improves their life and leaves the rest behind. They select when to buy on-line otherwise will continue to buy from the neighborhood store (Wind et al., 2002). This new model of consumer constitutes a hybrid model that combines behaviours of both traditional consumer and e-consumer. It uses the Internet not only for purchases, but also for the collection of information, which will be used in offline purchase. Wind et al. (2002), named this new type of consumer as "Centaurs" inspired from the ancient Greek mythology.

3. RESEARCH METHODOLOGY

In the present study a combination of convenience and judgmental sampling was used. The sample consisted of adult active Internet users aged between 18 and 60, which were the two main criteria to determine respondent eligibility for inclusion in this study. 350 (n=350) valid questionnaires were gathered. The sample size can be considered sufficient because:

1) The active Internet population in Greece is estimated to 600,000 users according to TREK Consulting (2001).
2) A similar research by White and Manning (1998) used a sample of 168 individuals, for the USA, where the active Internet population is more than 20 million users.

The data were collected using personal interviews. This method was chosen for its advantages (Hair et al., 2003). The fieldwork was conducted between

May-September 2003 in the two major cities of Greece, Athens and Thessaloniki. The statistical package SPSS ver. 10.0 was used for the data analysis. Statistical analysis of the survey data includes descriptive statistics (Frequencies and percentages) and inferential statistics (cross tabulation and degree of association (Cramer's V).

3.1. Research Hypotheses

Research ideas are usually stated as hypotheses. According to Creswell (2003) hypotheses are "predictions the researcher holds about the relationship among variables". Taking into account the objectives of the study the following research hypotheses have been formulated:

H1: Is there a relationship between consumers' visit on the websites of the products that they want to buy and their decision to buy them offline?

H2: Is there a relationship between the quality of the websites of the products that consumers want to buy and their intention to buy them offline?

3.2. The Questionnaire

For the purpose of verifying the above objectives a structured questionnaire has been prepared. A six-page questionnaire has been developed as the research instrument specifically for this purpose based on literature review, and the objectives of the study. After the questionnaire was developed, it was tested for content and face validity and pre-tested on a convenience sample of 50 respondents. Based on the feedback, some minor modifications were realised regarding the questionnaire layout and the wording.

The survey questionnaire was divided into three thematic parts. There were 7 general questions in section 1 covering many aspects of the Internet use. In particular, they examine the respondents' attitudes towards the Internet (i.e., the level of Internet usage, etc). Section 2 with 12 questions focused on the respondents' intention to buy an on-line product and their opinion regarding the level of satisfaction about on-line shopping. The measurement was implemented using a five point Likert scale with scores of 1 "very

unfavourable" to 5 "very favourable". Finally, section 3 was devoted to basic demographic information.

4. FINDINGS

4.1. Demographic characteristics

The sample comprises of individuals of varied demographics. There were 189 men (54%) and 161 women (46%). Ages of the respondents ranged from 18 to 60 years. Most of the sample (40.9%) was between the ages of 18 and 25 (143 respondents). Educationally, the biggest group belonged to respondents with a University degree (34.6%), while respondents with postgraduate degrees counted for 24.6%. With regards to occupation 37.1% of the respondents were white-collar workers, another 37.1% were university students, while the 20.3% of the respondents were civil servants. In terms of income 21.4% of the Internet users in this sample had monthly income more than 1,500€. However, all the income classes were almost evenly divided. Regarding the hours connected to the Internet, 107 respondents (30.6%) are connected about 2-5 hours weekly, while 90 respondents (25.7%), 82 respondents (23.4%), and 71 (20.3%) respondents are connected 5-8 hours, more than 8 hours, and less than 2 hours respectively.

4.2. Hypotheses Analysis

The first research hypothesis aimed to examine whether the consumers visit the products websites that they want to buy offline. The analysis of the contingency table of the hypothesis test shows that statistical differences exist between the variable website visits and offline purchasing (X^2=41.210, df=4, p=0.000). The degree of consistency is relatively high because of the Cramers' V=0.488. Thus, H1 was supported suggesting that consumers visit the website of the products which they purchase offline.

The sample was almost evenly divided in their responses; 173 sample participants (49.4%) answered that they visit the web sites of products that they want to buy offline before they realize the purchase. Of the 173 respondents, 63% (109) answered that they visit the websites sometimes, 19.1% (33)

answered very often, 3 (1.1%) always, while the rest 28 (8%) rarely. Also, 76, 9% declared that they seek alternatives through the Internet by visiting the websites of competitive products.

An amount of 177 respondents (50.6%) answered that they do not visit the products' web sites. The main reason for that is that they prefer a "live" shopping experience and thus, prefer to shop in the natural shop (i.e., super market). They consider visiting of websites waste of time, since they are boring, with insufficient and most times misleading information, while for these products they are informed mainly by other means, such as the television and the radio.

The main factors that would change this behaviour are mainly the benefits of discounts and offers, the existence of sincere information on the products, the possibility of feedback (web site evaluation, information for the product and the company, consumer testimony for the product, etc) via these web sites and mostly the existence of the notion of "value for money". According to respondents these websites in order to be more attractive and useful, they have to be faster, more functional, more attractive, with better planning and structure, easier navigation, while the biggest advantage would be the presentation of products via virtual reality.

The second research hypothesis was designed to explore if the quality of the websites of the products that consumers want to buy influence their intention to buy them offline. The analysis of the contingency table of the hypothesis test shows that statistical differences exist between the variable quality of the website and the intention to buy offline (X^2=57.062, df=8, p=0.000). The degree of consistency is quite high because of the Cramers' V=0.406. Thus, H2 was supported suggesting that the quality of the website of the products influence the consumers purchase intention offline. This finding could be considered consistent with other studies contention that website influence purchase intention in online environment (Chen and Wells, 1999; White and Manning, 1998).

With regard to the influence that the web site of a product has in the purchasing behavior of the consumer, 99 respondents (66.2%) expressed the

likelihood of purchasing the product offline because they were influenced by its web site, 5 respondents (2.9%) answered would definitely buy, while the rest answered unlikely.

From the positive characteristics the highest preference assemble the "practical/useful", "interesting", "informative" and "amusing", while from the negatives "confusing", "heavy" and "impersonal" (Table 1). The website characteristics that influence the consumers in order to characterize them positively are mainly “quality of information”, “planning” and “fast navigation.”

TABLE 1: EVALUATION OF WEB SITES

Characteristics	Frequencies	Percentage (%)
Positive		
Useful	82	46.3
Interesting	73	41.2
Informative	68	38.4
Attractive	41	23.2
Amusing	39	22
Concise	17	9.6
Innovative	16	9.0
Clear	6	3.4
Negative		
Confusing	36	20.3
Heavy	29	16.4
Out of data	27	15.3
Impersonal	25	14.1
Wordy	11	6.2
Hard to read	11	6.2

5. CONCLUSIONS

The most radical change in this digital era is not the development and expansion of new technologies as new communication and promotion channels, but the change in the consumer’s behaviour. The findings of this

study indicate that half of the consumers visit the websites of the products that they want to buy offline, and a significant number is influenced by them in their intention to purchase them in offline environment.

Day by day more enterprises sense the changes that befall the global commerce because of the Internet and tend to take advantage of its opportunities. The enterprises should use the Internet as a strategic business tool that can maximize the value of corporate identity and its brand names and increase their sales. Marketers must develop their Marketing strategies in which the top priority is the customer's service and satisfaction through multiple channels, conceiving the present buying behaviour of contemporary consumers, the "Centaurs".

5.1. Future Research

This study was exploratory in nature and made an initial attempt to search the influence of a company's presence in the Internet on the buying behaviour of a consumer in the physical market. Although the findings of the study may not be generalized without further empirical testing, this study adds to the overall knowledge about Internet and consumer behavior and it does provide a foundation for further studies. In light of the findings from this study, more research is needed to confirm these findings. Further, undertaking should expand the scope of the study using multiple measures and a nationwide based representative sample in terms of geography and demographics to achieve more accurate conclusions.

Also, in future works it is proposed that additional variables should be measured and more focus on websites of specific products (i.e., food and beverages) is needed. Other characteristics and variables that influence the satisfaction of consumers from the web sites of products that buy offline, their effectiveness, the influence and the effectiveness of advertising activities that exist in these web sites are some other aspects that should be studied.

REFERENCES

Ba, S. and Pavlou, P. (2002). Evidence of the Effect of Trust Building Technology in Electronic Markets: Price Premiums and Buyer Behavior, *MIS Quarterly*, Vol. 26, No. 3, 243-268.

Burke, R. R. (2002). Technology and the Customer Interface: What Consumers Want in the Physical and Virtual Store, *Journal of the Academy of Marketing Science*, Vol. 30, No. 4, 411-432.

Chen, Q. and Wells, W. D. (1999). Attitude Toward the Site, *Journal of Advertising Research*, Vol. 39, No. 5, 27-37.

Creswell, J. W. (2003). *Research Design. Qualitative, Quantitative, and Mixed Methods Approaches*, 2nd Edition, Sage, Thousand Oaks, CA.

Degeratu, A., Rangaswamy, A. and Wu, J. (2000). Consumer Choice Behavior in Online and Traditional Supermarkets: The Effects of Brand Name, Price and Other Search Attributes, *International Journal of Research in Marketing*, Vol. 17, No. 1, 55-78.

Georgiades, P., duPreez, J., Dowsland, B. and Simintiras, A. (2000). *Attitudes Toward On-line Purchase Behavior: Comparing Academic, Students and Others*, Working Paper, European Business Management School, University of Wales Swansea.

Goldsmith, R. E. and Lafferty, B. A. (2002). Consumer Response to Web Site and their Influence on Advertising Effectiveness, *Internet Research: Electronic Networking Applications and Policy*, Vol. 12, No. 4, 318-328.

Hair, J. F., Bush, R. P. and Ortinau, D. J. (2003). *Marketing Research. Within a Changing Information Environment*, McGraw-Hill, Boston.

Jayawardhena, C., Wright L. T. and Masterson, R. (2003). An Investigation of Online Consumer Purchasing, *Qualitative Market Research: An International Journal*, Vol. 6, No. 1, 58-65.

Kardaras, D. and Papathanassiou, E. (2000). The Development of B2C E-commerce in Greece: Current Situation and Future Potential, *Internet Research: Electronic Networking Applications and Policy*, Vol. 10, No. 4, 284-294.

Kau, A. K., Tang, Y. E. and Ghose, S. (2003). Typology of Online Shoppers, *Journal of Consumer Marketing*, Vol. 20, No. 2, 139-156.

Kotler, P., Jain, P. C. and Maesincee, S. (2002). *Marketing Moves*, Harvard Business School Press, Boston.

Koufaris, M. (2002). Applying the Technology Acceptance model and Flow Theory to Online Consumer Behavior, *Information Systems Research*, Vol. 13, No. 2, 205-223.

Kotler, P. and Armstrong, G. (2001). *Principles of Marketing*, 9th Edition, Prentice Hall, Upper Saddle River, NJ.

Lynch Jr., and Ariely, D. (2000). Wine Online: Search Costs Affect Competition on Price, Quality and Distribution, *Marketing Science*, Vol. 19, No. 1, 83-104.

Mathwick, C. (2002). Understanding the Online Consumer: A Typology of Online Relational Norms and Behavior, *Journal of Interactive Marketing*, Vol. 16, No. 1, 40-55.

Moynagh, M. and Worsley, R. (2002). Tomorrow's Consumer- the Shifting Balance of Power, *Journal of Consumer Behaviour*, Vol. 1, No. 3, 293-301.

Nie, N. H. and Erbring, L. (2000). Internet and Society: A preliminary report, *Stanford Institute for the Quantitative Study of Society*, 17 February.

Otto, J., Najdawi, M. and Caron, K. (2000). Web-user Satisfaction: An Exploratory Study, *Journal of End User Computing*, Vol. 12, No.4, 4-20.

Palmer, J. W. (2002). Web Site Usability, Design and Performance Metrics, *Information Systems Research*, Vol. 13, No. 2, 151-167.

Porter, M. (2001). Strategy and the Internet, *Harvard Business Review*, Vol. 79, No. 3, 63-78.

Priporas, C. V. (2003). Principles of E-Strategy in the "Developing" Greek E-Commerce (B2C), *Hellenic Academy of Business Administration Review*, Vol. 1, No.1, 55-65 (In Greek).

Ranganathan, C. and Ganapathy, S. (2002). Key Dimensions of Business to Consumer Web Sites, *Information & Management*, Vol. 39, No. 6, 457-465.

Saeed, K. A., Hwang, Y. and Yi, M. Y. (2003). Toward an Integrative Framework for Online Consumer Behavior Research: A Meta-analysis approach, *Journal of End User Computing*, Vol. 15, No. 4, 1-26.

Saunders, G. (2000). Commercial Use of the Internet: Some Pros and Cons, The *Journal of Applied Business Research*, Vol. 16, No. 1, 1-7.

Shankar, V., Smith, A. K. and Rangaswamy, A. (2003). Customer satisfaction and Loyalty in Online Environments, *International Journal of Research in Marketing*, Vol. 20, No. 2, 153-175.

Stafford, M. and Stern, B. (2002). Consumer Bidding Behavior on Internet Auction sites, *International Journal of Electronic Commerce*, Vol. 7, No. 1, 135-150.

Sultan, F. and Henrichs, R. (2000). Consumer Preferences for Internet Services over Time: Initial Explorations, *Journal of Consumer Marketing,* Vol. 17, No. 5, 45-62.

The Economist. (2004, May 15). A Perfect Market. A Survey of E-commerce. Special Report.

TREK Consulting. (2001). On–line Buying Behavior: The Greek Experience, *http://www.publicity-guide.gr*

Vijayasarathy, L. R. (2003). Shopping Orientations, Product Types and Internet Shopping Intentions, *Electronic Markets*, Vol. 13, No. 1, 67-79.

Vrechopoulos, A. P., Siomkos, G.J. and Doukidis, G. I. (2001). Internet Shopping Adoption by Greek Consumers, *European Journal of Innovation Management*, Vol. 4, No. 3, 142-152.

Ward, M. and Lee, M. (2000). Internet shopping, consumer search and product branding", *Journal of Product & Brand Management,* Vol. 9, No. 1, 6-20.

White, G. and Manning, B. (1998). Commercial WWW Site Appeal: How Does it Affect Online Food and Drink Consumers' Purchasing Behavior? *British Food Journal*, Vol. 100, No. 9, 413-418.

The Cyprus Journal of Sciences, Vol. 3, 2005/115-135

OPTIMAL ECONOMIC GROWTH IN THE MODEL WITH INCREASING RETURNS

ALEXANDER A. GOLUB*

ABSTRACT

This paper analyzes the Solow growth model – which assumes a convex-concave-convex production function. Such a function formalizes the phenomenon of increasing returns to scale. A production function with increasing returns results in multiple steady states, while one with constant returns results in a unique steady state. This paper analyzes the optimization problem with the convex-concave-convex production function and determines the conditions for a unique steady state in the growth model with increasing returns. Application of the results could be useful in understanding how a country with a relatively low endowment and low initial capital accumulation could ensure sustainable economic growth.

Key words: Increasing returns to scale, multiple steady states, sustainable economic growth

1. INTRODUCTION

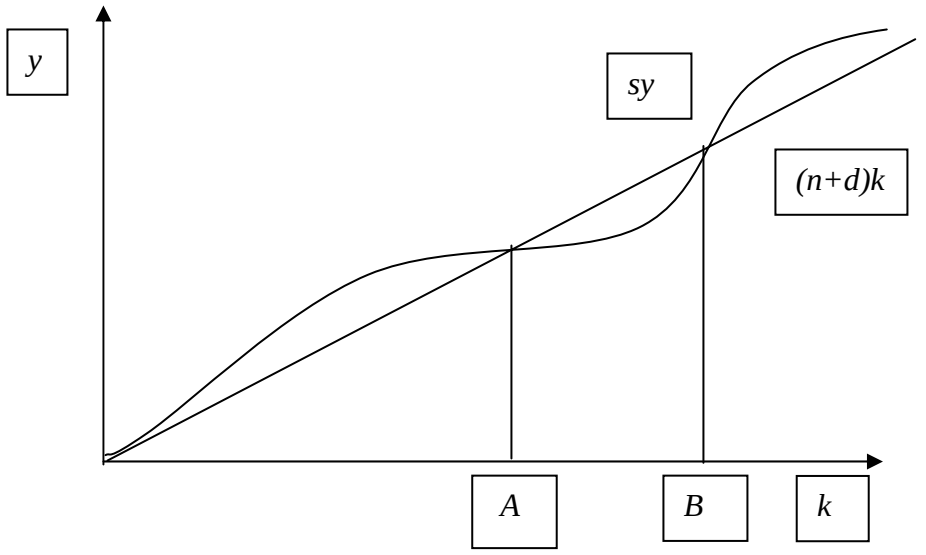
This paper analyzes the basic neoclassical growth model known as the Solow model, which assumes a convex-concave-convex production function (see Figure 1A). Consideration of such a function is a way to formalize the phenomenon of increasing returns to scale, which is essential to the new growth theory.

A production function with increasing returns to scale results in multiple steady states, while a production function with constant returns to scale results in a unique steady state. The existence of a unique steady state suggests convergence of per capita output across different countries over time, although

* Economist, Environmental Defense and Professor, "Higher School of Economics", State University, Moscow

the presence of multiple steady states means that the convergence of one group of countries is complemented by divergence of another group. Therefore, some countries demonstrate sustainable growth, while others end up in a poverty trap. This paper analyzes the optimization problem with a convex-concave-convex production function and determines the conditions for a unique steady state in the growth model with increasing returns. Application of the results to the growth theory could be useful in understanding how a country with relatively low endowment and low initial accumulation of capital per labor could ensure sustainable economic growth.

FIGURE 1A: EXAMPLE OF PRODUCTION FUNCTION WITH INCREASING RETURNS TO SCALE
(*A and B the steady state)*



The basic Solow model links the dynamics of output with the dynamics of production factors; thus, the selection of the production factors is as essential for a growth model as the selection of the production function. The neoclassical growth model links output *Y* with two production factors: labor *L* and capital *K*, and operates with production functions that have constant returns to scale and diminishing returns in capital and labor. This assumption narrows

down the choice of production functions, for example Cobb-Douglas or CES. Consider the Cobb-Douglas production function:

$$Y = AK^{\alpha}L^{1-\alpha}, \text{ where } 0 < \alpha < 1$$

Constant *A* denotes the skill level of labor.

The stock of labor grows exponentially and its growth rate *(n)* is assumed to be exogenous. Efficiency of labor is assumed to be constant (*A*), the capital stock *(K)* accumulation depends on the savings (investment) rate (*s*) and depreciation *(d)*, which are also assumed to be exogenous in the basic Solow model. Capital accumulation is equal to the difference between investment *sY* and depreciation of the capital stock *dK*:

$$\dot{K} = sY - dK$$

The goal is to find the equilibrium or steady state solution. The Solow model is solved in terms of capital accumulation per unit of labor, where $k = K/L$, and output growth per labor, where $y = Y/L$. Dividing the Cobb-Douglas production function by *L* and substituting *y* and *k* results in the following expression (1):

$$y = Ak^{\alpha} \qquad (1)$$

The function of this equation is presented in Figure 1B.

Capital accumulation per unit of labor (*k*) is determined by taking the difference between savings (*sY*) and depreciation (*dK*), while also taking into account exogenous growth of labor (*n*-population growth):

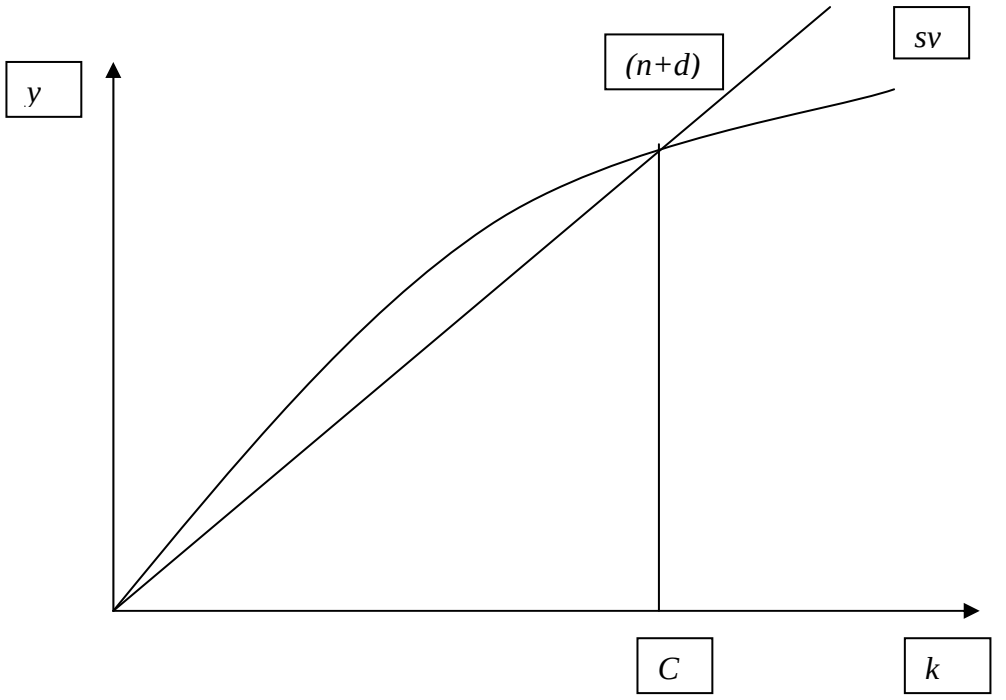
$$\dot{k} = sy - (n + d)k$$

The condition for equilibrium is the stable level of capital per unit of labor, i.e. we are looking for the point where $\dot{k} = 0$. This leads us to the fundamental Solow equation for the steady state solution:

$$sy = (n+d)k \qquad (2)$$

where *s*, is the investment or savings rate; *n* is population growth and *d* is capital depreciation. It is easy to see that equation (2) has a unique solution, which is point C in Figure 1B.

FIGURE 1B: THE NEOCLASSICAL TYPE OF PRODUCTION FUNCTION
(C is the steady state)



Lukas, Romer, Stiglitz, Jones and others have developed the modern growth theory over the last 20 years. Their most important innovation has been the explicit introduction of increasing return to scale. Therefore, in contrast to the neoclassical growth theory, which operates with concave production functions (with diminishing returns of production factors or constant returns to scale), the modern growth theory operates with production functions that have concave and convex segments (demonstrating increasing returns to scale on

some intervals) as shown in Figure 1A. The function of this shape can be found in almost any publication discussing the phenomenon of increasing return to scale: for example, Ros (2001), Hoff and Stiglitz (2001). It is usually a convex-concave-convex-concave function. In the neoclassical model on the other hand, the function would be strictly concave, as shown in Figure 1B.

In the literature, there are several different options for relaxing the assumption about constant returns to scale: with modification of the Cobb-Douglas function; by introduction of an additional multiplier; by adding a linear component in capital AK, as in the Jones and Manuelli model (see Barro and Sala-I-Martin, 1999, p. 161 or Jones (2002)); or simply through the Y=AK production function (see Jones, 2002, p.157). Lukas, Romer, Jones, Barro and others considered the accumulation of human capital, knowledge, ideas, and the acquisition of know-how as the primary reasons for the phenomenon of increasing returns. These authors considered the above factors as the main engine of economic growth for developed countries over the last few decades (see Jones (2003)). Paul Romer proposed a model which considered the complementary qualities of the accumulation of knowledge and ideas as the main reason for increasing returns (see Romer (1990), Evans et al. (1996) and (1998)). Some authors analyzed the role of "physical resources" (see Ayres and Warr (2002) and Galor and Moav (2002)). It is not our goal to contribute to the discussion of why increasing returns may occur, but rather to conduct a formal analysis of the optimization problem using the production function, which demonstrates increasing returns to scale in certain intervals, as shown in Figure 1A.

Application of a concave production function leads to a unique equilibrium or steady state in the growth model (see Figure 1B), while the introduction of increasing returns, using convex-concave-convex functions (as in Figure 1A), leads to multiple steady states or equilibria. The graphical illustration of multiple solutions for equation (2) can be found in different sources, for example, in Romer (2001), Meier and Stiglitz (2001), Evans et al. (1996), and Ros (2001). In the neoclassical models the equilibrium and the optimal solutions are always the same. However, this is not necessarily the case when a concave function is being used, which is convex-concave-convex-concave (or with a function which demonstrates increasing returns to scale or constant returns to production factors). Romer (1990), for example, demonstrated that

for models with increasing returns, the equilibrium solution is not optimal. He explained this through the presence of positive externalities generated by the accumulation of human capital, knowledge, and ideas. At the same time, Skiba (1978) and Haunschmied et al. (2003) proposed the optimization approach and showed that the optimal and equilibria solutions will be the same. If there are multiple equilibria (or steady states), the economy will end up in one of them. They demonstrated the existence of a threshold, which determines the transition or convergence path. If the initial level of capital is larger than the threshold level, then the economy converges to the high steady state (Skiba (1978)). Haunschmied et al. (2003) demonstrated the importance of two parameters: initial capital stock and investment rate. However, Skiba (1978) and Haunschmied et al. (2003) focused on the model with just one variable, which represents one production factor – capital. Labor was not represented in these models explicitly (see Skiba, 1978, p. 528 or Haunschmied et al, 2003, p. 6-7), while in Romer's model (Romer (1990)), labor as human capital accumulation plays a central role.

This paper demonstrates that under certain conditions the steady state and optimal solution will be the same for the growth model with increasing returns, which explicitly includes capital and labor.

The presence of multiple equilibria or multiple steady states leaves two questions: which solution will be sustainable or optimal; and how will the economy move from one state to another? To answer these questions, we propose a formal analysis of the problem using a production function linear in labor, and convex-concave in capital. In order to find the optimal solution for the growth model with increasing returns and to find sufficient conditions for the optimal solution, we use a production function similar to the one in Figure 1B.

2. FORMAL ANALYSIS OF THE OPTIMIZATION PROBLEM WITH A CONVEX-CONCAVE PRODUCTION FUNCTION

Most of the studies mentioned above concentrate on the question of how to explain the mechanism of increasing returns. We assume this to be given and

focus on a formal analysis of the production function, which demonstrates a variable returns to scale.

We define the function *f(k)* as continuous, for which first and second derivatives exist. The first derivative is always positive while the sign of the second derivative changes from positive to negative and back to positive several times. Therefore, the function is convex first, then concave, and convex again, and this change of convexity may repeat several times. However, *f(x)* may be approximated by a strictly concave function *F(k)* such as $\forall k \geq 0$ *F(k)>f(k)*. This function *f(k)* is presented in Figure 1A[1].

In this section we consider the problem of optimization, where total output *Y=f(k)L* is maximized. We maximize the total output *Y* while keeping labor and capital constant:

$$Max\ f(k)L \tag{3}$$

s. t.

$$kL \leq K \tag{4}$$

$$L \leq L^0 \tag{5}$$

$$k \geq 0;\ L \geq 0 \tag{6}$$

The problem (3)-(6) is similar to the basic Solow model with one difference in the definition of the production function, which is not concave in (3)-(6). In contrast to the problem solved by Skiba (1978) and Haunschmied et al. (2003), the problem (3)-(6) is formulated in the static form; however, production factors, capital and labor, are all presented as variables. We abstract from the dynamics issue for the moment and focus first on the optimal solution in the static form.

The necessary conditions for the optimal solution are the following:

$$\frac{\partial f(k)}{\partial k} = \lambda \tag{7}$$

$$\left(\frac{f(k)}{k} - \frac{\partial f(k)}{\partial k}\right) k = \mu \tag{8}$$

$$\lambda \geq 0, \mu \geq 0 \text{ , } k > 0, L > 0 \qquad (9)$$

Where λ and μ are Lagrange multipliers.

In addition to (7)-(9), the optimal solution should meet the conditions formulated in Statement 1 below.

Statement 1:

Let $f^* = \frac{f(k^*)}{k^*}$ be the global maximum of $\frac{f(k)}{k}$, then $\forall k < k^*$, and $\forall L \mid 0 \leq L \leq L^0$ which satisfies conditions (9)-(11). $\exists L^*; 0 < L^* < L^0$ such that $f(k^*)L^* > f(k)L$ holds, i.e. there is no chance that the optimal capital labor ratio (we also call this intensity) will be lower than k*, which will maximize average production.

Proof:

Since $\forall k^{**} < k^*$, $L^{**} = \frac{K}{k^{**}}$ $(L^* < L^{**} \leq L^0)$ and $L^* = \frac{K}{k^*}$, it is easy to see that $f(k^*)\frac{K}{k^*} - f(k^{**})\frac{K}{k^{**}} > 0$.

According to Statement 1, the increase of production acquired by the concentration of capital per unit of labor continues until the capital per labor ratio reaches the k^* level. Additional labor involved will lower *k* and will result in a decrease of production. Economies with a low *k* ratio may end up in a poverty trap as described, for example in Ros (2001). In labor-abundant economies defined in terms of the model (8)-(11) as economies with low *K/L* ratios ($K/L < k^*$), full employment leads to a reduction in efficiency, while the optimal concentration of capital per labor results in unemployment. Such a tradeoff between the optimum concentration of capital and employment does not exist in the basic Solow model, since the production function is strictly concave. Therefore, increasing returns may lead to unemployment (see also Weitzman (1994))[2].

The expressions (7)-(9), along with Statement 1, constitute the necessary conditions for the optimum. Since the problems (3)–(6) are not concave, the conditions (7)-(9) may not be sufficient. Below we propose further analysis of the properties for the optimal solution, which eventually leads to the formulation of sufficient conditions.

3. PROPERTIES OF THE OPTIMAL SOLUTION

It is possible that for some $K > 0$ and $L^0 > 0$; k, which satisfies conditions (7)-(9), is not unique. Let k_1 and k_2 satisfy the necessary conditions. Taking into account Statement 1, we will consider only k_1 and k_2, which are larger than k^*, i.e. $k^* < k_1 < k_2$.

Since both k_1 and k_2 satisfy (7) and (9), then they satisfy the conditions below:

$$\partial f(k)/\partial k \Big|_{k=k1} = \partial F(k)/\partial k \Big|_{k=k2} \qquad (10)$$

$$(f(k_1)/k_1 - \partial f(k)/\partial k \Big|_{k=k1}) * k_1 = (f(k_2)/k_2 - \partial f(k)/\partial k \Big|_{k=k2}) * k_2 \qquad (11)$$

The expressions (10) and (11) help with the graphical interpretation of multiple optimal solutions. Let's consider the tangent line g to the curve $f(k)$:

$$g = ak + b$$

Using (10) and (11) we come up with the following expressions for the tangent line g to the curve $f(k)$ at points k_1 (tangent line g_1) and k_2 (tangent line g_1):

$$g_1 = \partial f(k)/\partial k \Big|_{k=k1} * k + (f(k_1) - \partial f(k)/\partial k \Big|_{k=k1} * k_1) \text{ and}$$
$$g_2 = \partial f(k)/\partial k \Big|_{k=k2} * k + (f(k_2) - \partial f(k)/\partial k \Big|_{k=k2} * k_2)$$

According to (10) the slope factors are the same for both equations:

$$\partial f(k)/\partial k \Big|_{k=k1} = \partial f(k)/\partial k \Big|_{k=k2} = a$$

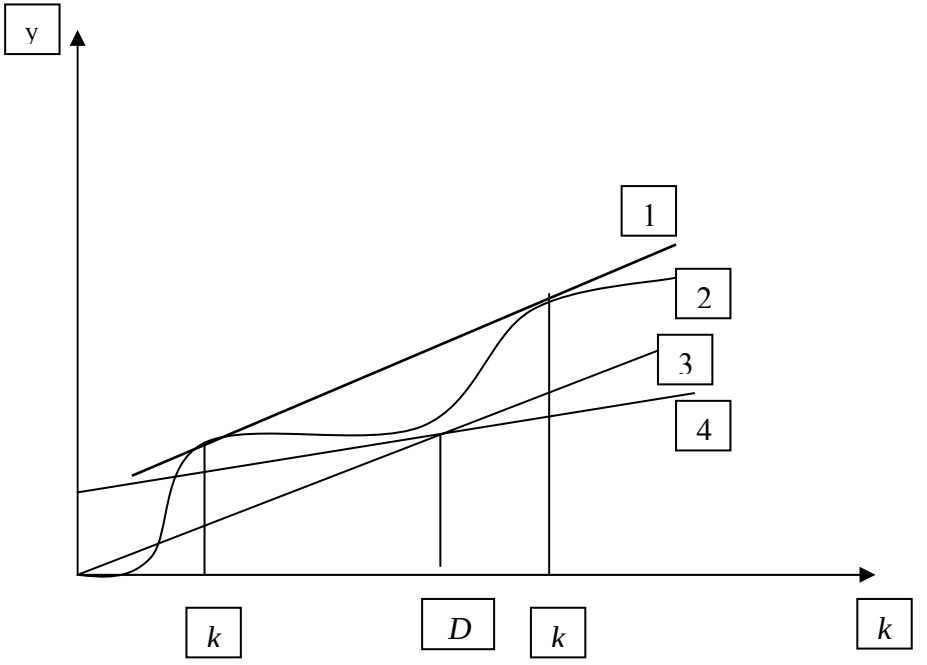
And from (11) we conclude that the coefficient *b* is also the same:

$$(f(k_1) - \partial f(k)/\partial k\big|_{k=k1} * k_1) = (f(k_2) - \partial f(k)/\partial k\big|_{k=k2} * k_2) = b$$

For the tangent line $g(k) = ak + b$ both *a* and *b* are positive. Otherwise (9) does not hold.

As shown in Figure 2, the optimal intensities for the old and new technologies correspond to the points where we can draw a tangent line to *f(k)*. Both points $\{k_1; f(k_1)\}$ and $\{k_2; f(k_2)\}$ are located on the same tangent line $g(k) = g_1(k) = g_2(k)$, where $k = K/L^0$. Note that in addition to $\{k_1; k_2\}$ there is the pair $\{k'_1; k'_2\}$. Neither k'_1 nor k'_2 satisfy the necessary condition, therefore neither could be the optimal solution. Only one set of intensities containing both *k* satisfies the necessary condition. For this set $\{k_1; k_2\}$ the tangent line is above the function *f(k)*, as shown in Figure 2.

FIGURE 2: INCREASING RETURNS AND MULTIPLE STEADY STATES



1 - is the aggregated production function *y* (a linear combination of the old and new technologies);
2 - *y(k)*;
3 - *(n+d)k*; and
4 - *sy*.

Since on the interval (k_1; k_2) the function *f(k)* is below the tangent line, we can say that,

$$\forall k \mid k_1 \le k \le k_2 \exists \alpha \mid 0 \le \alpha \le 1 \text{ such that}$$
$$f(k) \le \alpha f(k_2) + (1-\alpha) f(k_1). \qquad (12)$$

After we multiply (12) by L^0 we have the following expression:

$$f(k)L^0 \le \alpha L^0 f(k_2) + (1-\alpha)L^0 f(k_1);\ \forall k \mid k_1 \le k \le k_2. \qquad (13)$$

According to (13), switching from unique intensity *k* to the combination of k_1 and k_2 will increase output.

Suppose k_1 and k_2 are associated with two fundamentally different technological structures; then labor will be distributed between them in a proportion determined by α. Let L_1 be the labor associated with the "old" technological structure and L_2 be the labor associated with the "new" one.

Then $L_1 = (1-\alpha)L^0$ and $L_2 = \alpha L^0$. Let $\alpha = \dfrac{k-k_1}{k_2-k_1}$, then labor is distributed between the technologies in the following proportion:

$L_1 = L^0 - \dfrac{K - L^0 k_1}{k_2 - k_1}$, and $L_2 = \dfrac{K - L^0 k_1}{k_2 - k_1}$. It is easy to see then that

$$f(k_1)*(L^0 - \frac{K - L^0 k_1}{k_2 - k_1}) + f(k_2)\ \frac{K - L^0 k_1}{k_2 - k_1} > f(k)\, L^0.$$

Therefore, substitution of the single solution *k* with a solution which is a linear combination of two intensities, k_1 and k_2, results in an increase of output. Subsequently, on the interval (k_1; k_2), the production level is determined by the following expression:

$$Y(K,L^0) = Y(K,L) = f(k_1)*(L^0 - \frac{K - L^0 k_1}{k_2 - k_1}) + f(k_2) \frac{K - L^0 k_1}{k_2 - k_1}.$$

$$f(k_1) = \frac{f(k_2) - f(k_2)}{k_2 - k_1} K + f(k_1)L - \frac{f(k_2) - f(k_1)}{k_2 - k_1} Lk_1 = aK +$$

$$(\frac{f(k_1)}{k_1} - \partial f(k)/\partial k\big|_{k=k1})k_1 L$$

As defined above:

$$\partial f(k)/\partial k\big|_{k=k1} = a \text{ and } (\frac{f(k_1)}{k_1} - \partial f(k)/\partial k\big|_{k=k1})\, k_1 = b$$

As a result, $Y(K,L) = aK + bL$, and output per labor is $Y/L = ak + b$

$\forall k_1 \le Y / L \le k_2$.

Statement 2:

Conditions (7)-(9) are sufficient: $\forall k \mid k^* \le k \le k_1$ or $k \ge k_2$ [3]. Other intensities should be excluded from consideration, i.e. $\forall k \mid k_1 < k < k_2$, k is not an optimal solution.

Based on the above analysis we can determine the properties of the optimal solution for each combination of K and L.

From the discussion above we conclude:

1) If there are two intensities k_1 and k_2 ($k^* < k_1 < k_2$) that satisfy conditions (4)-(6), Statement 1, and $k_1 < K/L < k_2$, then the optimal solution will include both intensities, and labor will be distributed between them as shown above. This solution will be optimal.

2) Nothing in the set $\{k_1; k_2\}$ taken alone could constitute either an optimal or equilibrium solution. If we take just k_1, we end up with an oversupply of capital. In contrast, if we pick k_2, we will have unemployment. No intensity on the interval $(k_1; k_2)$ can be included in

any possible optimal solution for the problem (8)-(11) regardless of the variation of available labor and capital.

Therefore, on the interval $(k_1; k_2)$ we can substitute $f(k)$ with its tangent line to the function $f(k)$ touching $f(k)$ at points $\{k_1; f(k_1)\}$ and $\{k_2; f(k_2)\}$.

The new production function could be defined as follows:

$$Y = \frac{f(k^*)}{k^*} K \text{ if } \frac{K}{L} \le k^*$$

$$Y = f(k)L \text{ if } k^* < K/L < k_1 \text{ or } K/L > k_2.$$

$$Y = (ak + b)^* L \text{ if } k_1 \le K/L \le k_2, \text{ where } a = \partial f(k)/\partial k \Big|_{k=k1}$$

$$= \partial f(k)/\partial k \Big|_{k=k2} \text{ and } b = (f(k_1) - \partial f(k)/\partial k \Big|_{k=k1} * k_1) = (f(k_2) - \partial f(k)/\partial k \Big|_{k=k2} * k_2).$$

To rewrite this production function in terms of output per labor and capital per labor, we divide both sides of the equations by L.

4. THE STEADY STATE AND OPTIMAL SOLUTION FOR THE GROWTH MODEL WITH INCREASING RETURNS

It has been noted in the literature that the steady state reached on the segment with increasing returns (point B on Figure 1A), is not sustainable. It is also not optimal. Therefore, the economy will converge to a lower steady state (poverty trap) or to a higher steady state. Skiba (1978) proved the presence of this threshold. If capital stock (labor being fixed) is higher than this threshold, the economy will converge to the higher steady state; on the other hand, if the capital stock is below the threshold, then the economy will converge to the lower steady state. Haunschmied et al. (2003) demonstrated the influence of the investment rate on the convergence process. Weitzman (1994) introduced an exogenous threshold for the minimum labor input to begin new production. This was a way of formalizing increasing returns. Weitzman (1994) came to the conclusion that increasing returns could lead to unemployment.

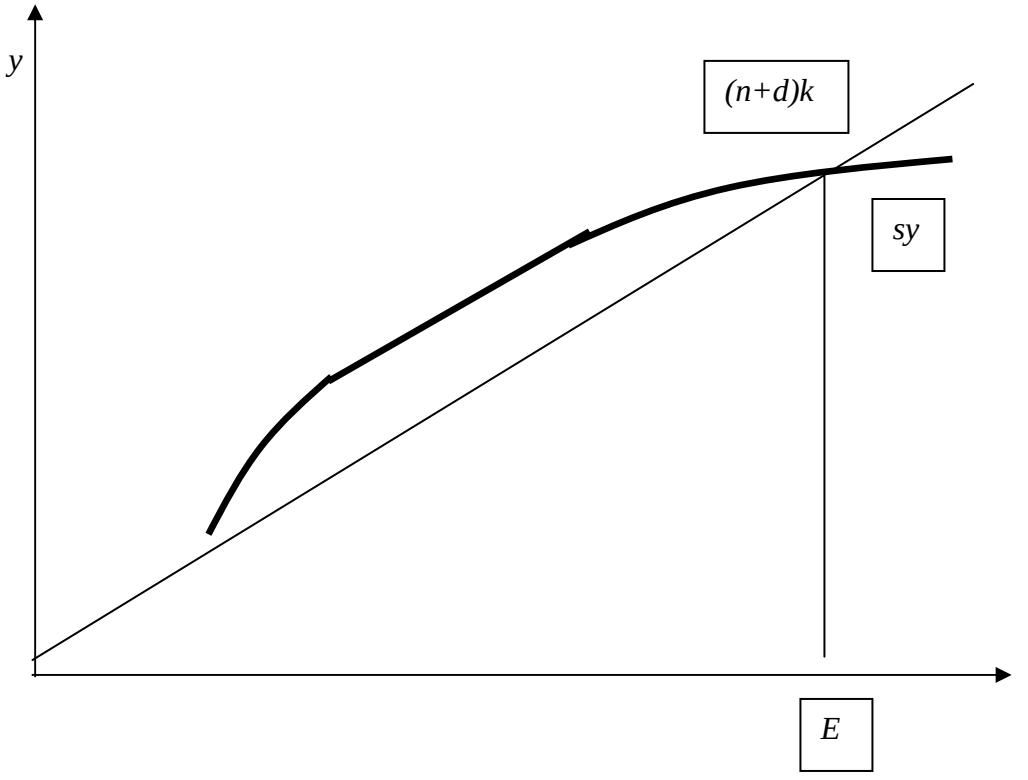
For a further search of the steady state solution, we will substitute the original $f(k)$ function with its tangent line on the segment $(k_1; k_2)$. We must consider the new function as a function of time, i.e. $y_t(k) = Y_t(K;L)/L = Y(K_t; L_t)/L_t$. Let $\dot{L} = 0$ and $\dot{k} = sy(k) - (d+n)k$. We have the same condition for the steady state as (2) for the basic Solow model: $sy(k) = dk$ (since $n = 0$).

The new function defined above allows us to introduce a different set of steady states in contrast to the results for the growth model with the function $f(x)$. For example, point *A* or *B* (in Figure 1A) is no longer a steady state. The new steady state will appear on the interval $(k_1; k_2)$.

One important conclusion is that the economy can now avoid a poverty trap, if existing institutions provide a climate for innovation and initial concentration of capital for the limited number of workers.

There are two possibilities: a) the new steady state appears in the interval $(k_1; k_2)$, as shown in Figure 2; b) one steady state is to the right of the interval $(k_1; k_2)$, as shown in Figure 3 (point E).

FIGURE 3: STEADY STATE BEYOND k_2



In both cases, the economy could reach a higher level of capital accumulation per unit of labor and could experience stable growth on the interval $(k_1; k_2)$. If, for example, the initial capital accumulation is in the neighborhood of point *A* in Figure 1B, then an economy represented as a combination of two sectors would skip the steady state *B* (which is, however, supposed to be the sustainable steady state, but not optimal) and grow to the point when capital per labor reaches level *D* (see Figure 2) or *E* (see Figure 3). Therefore, an economy with relatively modest initial endowment could have long-term sustainable growth if there are institutions supporting technological innovations.

5. TRANSITIONAL DYNAMICS

Now we estimate the rate of economic growth on the interval $(k_1; k_2)$ and the rate of transition from the old to the new technological structure. Output in year t is determined by formula (14):

$$Y_t(K,L) = f(k_1)\left(1 - \frac{K_{t-1} + sY_{t-1} - k_1}{k_2 - k_1}\right) + f(k_2)\frac{K_{t-1} + sY_{t-1} - k_1}{k_2 - k_1} \qquad (14)$$

From (14) we have that

$$\frac{Y_t - Y_{t-1}}{Y_{t-1}} = as \qquad (15)$$

where, $a = \dfrac{f(k_2) - f(k_1)}{k_2 - k_1}$.

It is also easy to generalize (15) for the continuous case $\dot{Y} = as$ or $Y_t = ast + Y_0$, where $Y_0 = f(k_1)L$.

The following expression describes migration of labor from an old to a new structure:

$$\dot{L} = \frac{s}{k_2 - k_1} \text{ or } L_t = \frac{st}{k_2 - k_1} + L_0 .$$

Since the transition period begins with no labor associated with the new technology (at least in this simple model), then $L_0 = 0$. If we consider a more complicated model with production function $Y(K,L)$, non-linear in L[4], and, moreover, if $\forall K_0 > 0$, the function $Y(K_0, L)$ is convex-concave; in L there should exist a threshold L_0. This means that the transition to the new technological structure requires a certain accumulation of labor ready to work in a new sector and as well as the corresponding capital.

Since we know the rate of substitution of the old technology for the new technology, we can analyze the dynamics of the aggregated capital:

$$k_t = k_1\left(1 - \frac{st}{k_2 - k_1}\right) + k_2\frac{st}{k_2 - k_1} = k_1 + st.$$

The last expression looks very much like the "AK" model. Therefore, the AK model is applicable when the transition is occurring. After the transition to the new technological structure is completed, further economic growth would be described by a concave segment of the *f(k)* function. Economic growth would gradually slow down until the transition to the new technological structure has begun.

When both technologies are present in the optimal solution, $\frac{\partial \lambda}{\partial t} = \frac{\partial \mu}{\partial t} = 0$ and $\frac{\partial Y}{\partial t} = const$.

This property of the optimal solution is very important. The constant economic growth will continue until the share of new technology reaches the point when the average weighted aggregated intensity becomes equal to *D* (see Figure 2) or *E* (Figure 3).

Table 1 describes properties of the optimal solution with respect to different levels of available labor resources and capital accumulation.

TABLE 1: PROPERTIES OF THE OPTIMAL SOLUTION

Capital per labor ratio (K/L^0)	Optimal k	Optimal L	□	□	Comments
$K/L^0 \leq k^*$	$k= K/L^0$	$L=K/k^*$ $L \to L^0$	Positive	0	Part of labor would be unemployed until capital stock reaches the level $K/k^*= L^0$
$k^*<K/L^0 <k_1$	$k= K/L^0$; $k \to k_1$	$L= L^0$	Positive	Positive	Full employment - additional investment would be evenly distributed across the economy to increase the capital per labor

					ratio
$k_1<K/L^0<k_2$	Optimal solution includes both[5] intensities k_1 and k_2	$L_1 \to 0$ while $L_2 \to L^0$	Positive	Positive	Two sectors of the economy coexist: one with low capital per labor ratio, and another with high ratio. The first is gradually contracted, while the second grows. Combination of both sectors allows economy to keep full employment during transition. Labor is distributed between two production processes with relatively low and relatively high intensities
$K_2<K/L^0$	$k= K/L^0$	$L= L^0$	Positive	Positive	Full employment

6. CONCLUSION

Most studies on the increasing returns phenomenon concentrate on the question of how to explain the mechanism of increasing returns. For the purposes of this study, the mechanism of increasing returns is assumed to be given and focus is placed on a formal analysis of the production function in general terms, which demonstrates variable returns to scale.

This paper presents the sufficient condition of the optimal solution for the non-concave optimization problem with the production function, which contains segments with increasing and decreasing returns. Under some circumstances, as described in this paper, the solution to the problem would have two optimal levels of capital intensity per unit of labor, which together constitute the optimal solution. We interpret this situation as the presence of

two sectors in the economy with fundamentally different levels of technology. In this case, the output per unit of labor could be described linearly in the k function that is the tangent line to the curve $f(k)$.

The optimal solution, which is the combination of two different intensities, differs from the steady state solution, which contains only one intensity. The optimal transition presupposes a gradual reduction of the "old" sector share, along with a substitution for it by the new one. However, this paper did not discuss the sustainability of this solution. The transition to this solution assumes an optimal level of labor migration from the "old" sector to the "new" one. Thus, the next step should be an analysis of governmental intervention in the transition process, for example, through the support of education and the accumulation of human capital to increase the fraction of labor prepared to work in the "new" sector. Other instruments, such as support of R&D, etc. should be analyzed, but are beyond the scope of this paper.

NOTES

1. For simplicity, further analysis is presented for convex-concave-convex-concave functions.

2. Weitzman assumed the presence of a threshold (minimum input of labor to start new production), which demonstrated how this threshold appears.

3. We formulate the sufficient conditions for the convex-concave-convex-concave function however Statement 2 could be generalized for a function that changes concavity several times.
4. Some analysis of such a function is presented in Gerasimovich and Golub (1988).

5. Let labor be constant and equal to L^0 and let stock of capital be increasing. At some point, when capital accumulation reaches a certain level $K = k_1 L^0$, all additional investment is into the new technology, with intensity k_2. Simultaneously, some labor previously connected to the old technology will shift to the new one. In contrast, the neoclassical model with a concave down production function suggests that all additional capital will be spent to even out the increase of intensity.

REFERENCES

Ayres, R. and B. Warr (2002). *Economic Growth Models and The Role of Physical Resources*, INSEAD Working Papers.

Barro, R. and X. Sala-I-Martin (1999). *Economic Growth*, The MIT Press, Cambridge, MA.

Evans, G., Honkapohja, S. and P. Romer (1998). Growth Cycles, *American Economic Review*, Vol. 88, 495-515.

Evans G., Honkapohja, S. and P. Romer (1996). *Growth Cycles*, NBER Working Paper in capital (*K*) er Series, Working Paper 5659, National Bureau of Economic Research, Cambridge, MA.

Galor, O. and O. Moav (2002). *From Physical to Human Capital Accumulation: Inequality and the Process of Development*, Brown University Working Paper, No.3, pp. 99-27.

Gerasimovich, V. and A. Golub (1988). *Methodology for Natural Resource Valuation*, Nauka, Moscow.

Haunschmied, J.L., Kort, P.M., Hartl, R.F., and G. Feichtinger (2003). A DNS-Curve in a Two State Capital Accumulation Model: a Numerical Analysis, *Journal of Economic Dynamics and Control*, Vol. 27, 701-716.

Hoff, K. and J. Stiglitz (2001). Modern Economic Theory and Development, in G. M. Meier and J. Stiglitz, eds., *Frontiers of Development Economics: the Future in Perspective*, 389-359.

Jones, C. (2003). *Growth and Ideas*, Preliminary version.

Jones, C. (2002). *Introduction to Economic Growth*, Second Edition, Stanford University, W.W. Norton & Company, New York, London.

Meier, G. and J. Stiglitz, eds. (2001). *Frontiers of Development Economics: the Future in Perspective*, The World Bank and Oxford University Press.

Romer, D. (2001). *Advanced Macroeconomics*, Second Edition, University of California, Berkley, McGraw-Hill Higher Education.

Romer, P. (1990). Endogenous Technological Change, *Journal of Political Economy 98*, October, Part 2, S71-S102.

Ros, J. (2001). *Development Theory and the Economics of Growth*, The University of Michigan Press, Ann Arbor.

Skiba, A.K. (1978). Optimal growth with a convex-concave production function, *Econometrica*, Vol. 46, No. 3, May 1978, 527-539.

Weitzman, M.L. (1994). Increasing Returns and the Foundations of Unemployment Theory, in J.M. Buchanan and Yong J. Yoon, eds., *The Return to Increasing Returns*, University of Michigan Press, 251-272.

The Cyprus Journal of Sciences, Vol. 3, 2005/137-166

THE KNOWLEDGE-BASED ECONOMY AND THE EUROPEAN NATIONAL POLICY OF INNOVATIONS

GEORGE M. KORRES* and GEORGE TSOBANOGLOU**

ABSTRACT

Research and Development and technical change are directly related with industrial infrastructure, productivity effects and regional development. The term «national system of innovations» indicates the national technological capabilities, and also the structure and the planning on research and development. European technological policy has an important role for the economies of member states. Technological policy aims to reinforce the competitiveness, and to succeed the convergence between member states. The purpose of this paper is to analyse the framework of knowledge-based economy and also to examine the evaluation and the development of Community's policy and how it can be implemented to the member states and the effects on economic integration. It also attempts to examine the role of national policy of innovations and the effects on sustainable development and in particular, the implications on growth, economic integration, regional development and social change.

Keywords: Innovation, knowledge economy, technological policy, convergence, national system of innovations, new technologies, competitiveness, technological harmonisation and integration, convergence, development

1. INTRODUCTION

Europe's overall economic performance experienced a significant weakening, after years of exceptional growth by European standards. The Gross Domestic Product (GDP) of the European Union grew by 1.6% in 2001, a reduction of nearly 2% in comparison to 2000, when the highest

* Assistant Professor, University of the Aegean, Department of Geography, University Hill, Mytiline, Lesvos, Greece

** Assistant Professor, University of the Aegean, Department of Sociology, Mytilene, Lesbos, Greece

growth rates of the last fifteen years were recorded. Economic growth gradually slowed down in 2002 and more or less stagnated in the first half of 2003. Most of the world's other main economies also experienced a slowdown and some of them even showed negative growth rates (i.e. real GDP actually declined). The US economy, after years of vigorous growth well ahead of the figures registered in the European Union, encountered near-stagnation in 2001. Japan, which had hardly recovered from the weak years, reported economic growth very close to zero for the last two years.

Investment in research and development (R&D) rose in 2001 and into 2002, as did investment in software in several countries. Information and communication technology (ICT) continued to diffuse to households and businesses and electronic commerce continued to gain in importance, despite the slowdown in parts of the ICT sector. The growing role of knowledge is reflected in economic performance. In Australia, Canada, Finland, Ireland and the United States, the overall efficiency of capital and labour - multi-factor productivity (MFP) - increased considerably over the 1990s, partly thanks to rapid technological progress and the effective use of ICT.

The ratio of trade-to-GDP increased by about 2 percentage points over the 1990s in the United States and the European Union, although it remained stable in Japan. Over the 1990s, manufacturing, particularly high-technology industries, was increasingly exposed to international competition.

• In 1999, OECD countries made 99.268 patent applications to the European Patent Office (EPO), based on priority date, a 68 % increase from 1991.
• The European Union (EU) accounted for 47% of total OECD patent applications to the EPO, significantly above the United States (28 %) and Japan (18%).
• Among European countries, Germany has by far the largest share with 20.5% of total EPO applications, more than the combined shares of France, the United Kingdom, Italy and the Netherlands. Patent applications from Korea, Ireland and Finland increased sharply over the 1990s (annual growth rates of 16 % or more).

Researchers are viewed as the central element of the research and development system. They are defined as professionals engaged in the conception and creation of new knowledge, products, processes, methods and systems and are directly involved in the management of projects. For those countries that compile data by qualification only, data on university graduates employed in R&D are used as a proxy. The number of researchers is here expressed in full-time equivalent (FTE) on R&D (i.e. a person working half-time on R&D is counted as 0.5 person-year) and includes staff engaged in R&D during the course of one year. Underestimation of researchers in the United States is due to the exclusion of military personnel in the government sector. The business enterprise sector covers researchers carrying out R&D in firms and business enterprise sector institutes. While the government and the higher education sectors also carry out R&D, industrial R&D is more closely linked to the creation of new products and production techniques, as well as to a country's innovation efforts.

This paper aims to analyse and examine the evaluation of the knowledge based economy and the development of Community's policy and how it can be implemented to the member states and the effects on economic growth and integration. It also attempts to examine the role of knowledge based economy and innovation policy and also on the effects on sustainable development and in particular on economic integration, and regional development.

2. SELECTED INDICATORS & METHODOLOGY FOR MEASUREMENT OF KNOWLEDGE-BASED ECONOMY

This section provides an overview of progress towards this important target using two «composite indicators». In the past years indicators relating to the high-tech and medium high-tech industries (HT/MHT industries) and knowledge intensive services (KIS) have formed part of the set of benchmarking indicators. A country's performance in the knowledge-based economy is not measured simply by outputs of science and technology, but must also be judged in relation to the important goal of increasing its competitiveness. Indeed these different aspects of performance are closely linked. A competitive economy is increasingly understood as an economy able to achieve sustained rises in standards of living for its population at low levels of

unemployment (European Commission, 2001b). The key determinant of competitiveness is labour productivity. Gains in labour productivity are the result of increasing human capital, capital deepening and technical progress or innovation as measured by total factor productivity. The degree of innovativeness is determined by firms' own R&D activities leading to new products or processes and by spill-over effects that magnify the benefits of own R&D efforts, but also by diffusion effects associated with imported technology and the presence of multinational firms (European Commission, 2001b).

While the indicators to measure the performance achieved by countries in moving towards a more knowledge-based economy are all quantitative, they are proxies for a qualitative change towards the set goal. Scientific publications are a proxy for the knowledge produced predominantly in academia, while patents inform about technological achievements. The degree of innovativeness is reflected in the importance of value added and employment in medium and high-tech industries and knowledge-intensive industries, in the technology balance of payments, and in high-tech exports.

Speeding up the transition to the Knowledge-based Economy has been an important objective of all European policies during the last years. These indicators attempt to capture the complex, multidimensional nature of the knowledge-based economy by aggregating a number of key variables, and, expressing the result in the form of an overall index. The two composite indicators used here refer to the overall investment and performance in the transition to the knowledge-based economy. They focus on the «knowledge dimension» of that transition and, therefore, do not take into account the other dimensions (e.g. employment, sustainable development, etc.) of the Lisbon Agenda.

In order to advance effectively towards the knowledge-based economy, countries need to invest in both the creation and the diffusion of new knowledge. The composite indicator of investment in the knowledge-based economy addresses these two crucial dimensions of investment. It includes key indicators relating to R&D effort, investment in highly-skilled human capital (researchers and PhDs), the capacity and quality of education systems (education spending and life-long learning), purchase of new capital

equipment that may contain new technology, and the modernization of public services (e-government). Table 1 shows the sub-indicators of this composite indicator.

TABLE 1: COMPONENT INDICATORS FOR THE COMPOSITE INDICATOR OF INVESTMENT IN THE KNOWLEDGE-BASED ECONOMY

Sub-indicators	**Type of knowledge indicator**
Total R&D expenditure per capita	Knowledge creation
Number of researchers per capita	Knowledge creation
New S&T PhDs per capita	Knowledge creation
Total Education Spending per capita	Knowledge creation and diffusion
Life-long learning	Knowledge diffusion: human capital
E-government	Knowledge diffusion: information infrastructure
Gross fixed capital formation (excluding construction)	Knowledge diffusion: new embedded technology

Source: DG Research Key Figures 2003-2004

Investing more in knowledge is, however, only half the story. Investment also needs to be allocated in the most effective way in order to increase productivity, competitiveness and economic growth. For this to happen, and to be sustainable, investment in knowledge thus has to induce a higher performance in research and innovation and increased labour productivity, an effective use of the information infrastructure and a successful implementation of the education system. This relationship between investment and performance, however, is very complex and certainly not linear. It depends partly on favourable framework conditions and policies. Moreover, there is always a time-lag between investment and a recorded increase in performance.

The second composite indicator presented here regroups the four most important elements of the performance in the transition to the knowledge-based economy: overall labour productivity, scientific and technological performance, usage of the information infrastructure and effectiveness of the

education system. Table 2 illustrates some indicators for the performance in the knowledge-based economy.

TABLE 2: COMPONENT INDICATORS FOR THE COMPOSITE INDICATOR OF PERFORMANCE IN THE KNOWLEDGE-BASED ECONOMY

Sub-indicators	**Type of knowledge indicator**
GDP per hours worked European and US	Productivity S&T performance S&T performance
Patents per capita Scientific publications per capita E-commerce Schooling success rate	Output of the information infrastructure Effectiveness of the education system

Source: DG Research Key Figures 2003-2004

Basic research plays an important role in the R&D system. It generates new knowledge and understanding that provide the foundation for applied research and development. Because basic research provides reliable information on areas of future applications, more intense knowledge creation through basic research could be seen as a way to enhance innovation activities.

In general terms, basic research has been under mounting pressures during the past decade or so. Because of short-term needs and economic priorities, there has been a tendency towards increasing the share of applied research and development in total R & D expenditure. However, the situation is very mixed, with some countries making more resources available for basic research and others less. In many countries, basic research still has a high status in the agenda of science, technology and innovation policies. There are good reasons for that. For instance, the emerging science-based areas of biotechnology and nanotechnology are promising areas for future applications and commercial activities. Public funding of R&D gives governments an instrument for directing resources to chosen fields.

Human resources are the vital elements of R&D and of all other activities related to S & T (European Commission 2003a). If the R&D

expenditure target of 3% of GDP is achieved, the human resources for research will have to be available.

Education, especially at universities is seen as a crucial factor in Europe's transition to a knowledge-based economy (European Commission 2003b). Ideally, researchers are recruited from university graduates in the fields of science and engineering. The effort and performance of the supply side of human resources in S&T are reflected in the number of new university graduates and PhDs. Additional information is provided by the numbers of female university graduates, enrolment of foreign students, expenditure on higher education, secondary educational attainment and lifelong learning.

Scientific publications are increasingly used as a measure of scientific performance. Especially at the policy level, S&T related decisions are more and more based on recent scientific performances. Scientific indicators are not perfect, but the measurement of publications, citations, or scientific impact has occupied a growing number of specialists who have developed sophisticated indicators.

Patents allow inventors to protect and exploit their inventions over a given time period, and provide a valuable measure of the inventiveness of countries, regions and enterprises. Moreover, since they disclose information about new inventions, patents also play a role in the diffusion of knowledge. Patent indicators not only help to shed light on patterns of technological change, but also measure activities that are closely associated with competitiveness in many important international markets. Smaller Member States show the strongest growth, but patenting by Acceding countries remains low. The EU continues to be less present in the US Patent and Trademark Office (USPTO) than the US is in the European Patent Office (EPO). While around 47% of EPO patent applications come from EU-15 countries, compared with 28% and 17% from the US and Japan respectively, the EU-15 share of USPTO patents was only 16% (with the US at 52% and Japan at 21%). Since 1995, Portugal and Ireland have shown strong growth in their patent shares at EPO and USPTO, but Austria, France, Italy and UK have all seen their shares of patents fall in both systems over the same period. Nevertheless, there are signs that the number of patents from the Czech Republic, Hungary, Slovakia and Slovenia are increasing.

The share of so-called «knowledge workers» in a country's total employment and its ability to produce high-tech products and sell them on international markets thus constitute important indications of international economic success. The relationship between high-tech, knowledge intensive activities and competitiveness is in no way straightforward and should not be interpreted in a mechanistic way. However, it is clear that increasing the qualification level of the labour force, while at the same time creating and applying new knowledge, represents a precondition for future sustained growth in Europe, and, for its ability to compete internationally and to keep unemployment down.

Exports of high-tech products reflect a country's ability to commercialize the results of research and technological innovation in international markets. That is the extent to which countries' exports are more or less focused on high-tech products.

The value added of high-tech and medium high-tech manufacturing as a percentage of total value added, gives an indication of the overall importance of high-tech sectors in the economy. It would be expected that with a gradual shift to the knowledge-based economy, the value added of those industries with a higher component of R&D should grow at the cost of other, more traditional industries.

3. THE ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN KNOWLEDGE-BASED ECONOMY

The share of ICT in total non-residential investment doubled and in some cases quadrupled between 1980 and 2000. In 2001, it was particularly high in the United States, the United Kingdom and Sweden. In many countries, the share of software in non-residential investment multiplied several times between 1980 and 2000. Available data for 2001 indicate that ICT share in total investment declined from 2000 to 2001.

In OECD countries, access to telecommunications networks has increased in recent years by more than 10 % a year, especially in countries with lower penetration rates, such as Poland, Mexico and Hungary. Wireless access has

grown particularly fast. The Internet also continues to diffuse rapidly. Germany had 84.7 Web sites per 1000 population in 2002, followed by Denmark (71.7) and Norway (66.4). Mexico, Turkey, Greece and Japan all had less than three Web sites per 1000 population.

Broadband has diffused most widely in Korea, Canada, Sweden, Denmark, Belgium and the United States. In Denmark and Sweden, one out of five enterprises accesses the Internet through a connection faster than 2Mbps. In Italy and Greece, relatively few firms have such a rapid Internet connection. In Canada, Ireland, Spain and Sweden, however, more than 40% of enterprises still connect to the Internet via dial-up. In Denmark, Germany, Sweden and Switzerland, some two-thirds of households had access to a home computer in 2002. In many other OECD countries, the share is less than 50%. Data on Internet access by household size show that Internet access is more frequent in households with children than in households without.

At the end of 2001, there were 77.5 million Internet subscribers to fixed networks in the United States, approximately 24 million in Japan, more than 23 million in Korea, almost 15 million in Germany and 13.6 million in the United Kingdom. A ranking in terms of Internet subscribers per capita places Iceland, Korea, Denmark, Sweden and Switzerland at the top of the list. The number of secure servers per capita increased significantly between July 1998 and July 2002, a sign of the growing importance of security for Internet applications. Iceland has the highest number of secure servers per capita, followed by the United States, Australia, Canada and New Zealand.

Men use the Internet more than women in all countries for which data are available. More than eight out of ten people in Switzerland, Austria, the United States, Denmark and Sweden use the Internet for e-mail. It is also commonly used to find information about goods and services, particularly in Sweden, Denmark and Finland. In the United States, almost 40% of Internet users buy on line, as do many users in Denmark, Sweden and Finland. In Portugal and Sweden, about half of all Internet users play games on line and/or download games and music. In Sweden and Denmark, more than half of all Internet users utilize e-banking.

In many countries, almost all enterprises with ten or more employees use the Internet. In Finland, Denmark, Canada, Sweden and Ireland, two-thirds or more of such enterprises have Web sites. The Internet is less used by smaller than by larger enterprises, and differences among countries are more striking when small enterprises are compared. Internet penetration in enterprises with ten or more employees also varies considerably across sectors. In the financial sector, almost all firms use the Internet. The retail sector seems to lag behind, particularly in countries with low overall Internet use by enterprises.

Internet sales range between 0.3% and 3.8% of total sales. Electronic sales, *i.e.* sales over any kind of computer-mediated network, reach 10% or more of sales in Austria, Sweden, Finland and Ireland. In the US retail sector, the share of electronic sales in total sales grew by 70% between the fourth quarter of 2000 and the fourth quarter of 2002. Large firms use the Internet more frequently than small ones to sell goods and services. It is also more common to purchase than to sell over the Internet. As many as two-thirds or more of enterprises with 250 or more employees in Australia, Canada, Denmark and Finland buy goods or services via the Internet.

The ICT sector grew strongly in OECD economies over the 1990s, particularly in Finland, Sweden and Norway. In Finland, the ICT sector's share of value added doubled over 1995-2001 and now represents over 16.4% of total business sector value added. In most OECD countries, ICT services have increased their relative share of the ICT sector, owing to the increasing importance of telecommunication services and software. In 2000, the ICT sector accounted for about 6.6% of total business employment in the 21 OECD countries for which estimates are available. Over 1995-2000, OECD area employment in the ICT sector grew by more than 3 million, *i.e.* an average annual growth rate of over 4.3% a year, more than three times that of overall business sector employment. ICT services were the main driver of employment growth.

4. EUROPEAN POLICY AND LISBON STRATEGY TOWARDS THE KNOWLEDGE-BASED ECONOMY

The Lisbon strategy becomes all the more important (Spring Report: European Commission, 2003d, p.29). As decided by the Heads of State and Government at the Lisbon Summit in 2000, this strategy aims at transforming the European Union by 2010 into «the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion». The set of measures and decisions taken then, better known as «the Lisbon strategy», entail reforms in three main dimensions:

(a) Further consolidation and unification of the European economic environment;
(b) Improvement of the creation, absorption, diffusion and exploitation of knowledge; and
(c) Modernization of the social model.

Thus not only does the Lisbon strategy remain Europe's overall roadmap to higher and sustainable economic growth, but also European policy-makers acknowledge that the progress needs to be accelerated for growth recovery. This year's Spring Report, for instance, stated that *"The Union's priority for the next 12 months must be to stimulate investment in knowledge and innovation alongside faster structural changes in order to boost productivity and employment"* (European Commission, 2003d, p.33). More recently, the European Council of Thessaloniki (European Council, 2003) asked the European Commission to launch an initiative in cooperation with the Investment Bank to support growth by increasing overall investment and private sector involvement in infrastructures and in research and development (European Council, 2003, p.17; European Commission, 2003e, 2003f).

Enlargement too, reinforces the case for accelerating the process. Integrating new Member States does not imply a rewriting of the Lisbon strategy: the targets for the whole of the Union remain the same for the EU-25. The Lisbon strategy forms a common basis for reforms needed in the new Member States as well as in the EU-15, and therefore is a sound tool for

integration. However, enlargement also means that additional efforts are needed from Member States to keep the Union on track in its transition to a knowledge-based economy.

Education, research and innovation are one of the main means to achieve the overall Lisbon objective. Recognizing the pivotal role of education and training, the European Council invited Ministers of Education «to reflect on the concrete future objectives of education systems» and to concentrate on «common concerns and priorities». Hereby the Lisbon Council launched an unprecedented process in the area of education and training helping Member States to develop their own policies progressively by spreading best practice and achieving greater convergence towards the main EU goals.

The European Council of Barcelona (March 2002) emphasized the importance of research and innovation by setting the goal of increasing the level of expenditure in research and development to 3% of GDP by 2010. While investing more in R&D is one part of the equation, another is better co-ordination of European research. This has been initiated through the creation of the European Research Area (ERA) and related policy actions, such as the «benchmarking of national research policies». The European Research Area is the broad heading for a range of linked policies that attempt to ensure consistency of European research and facilitate the research policies of individual member states in order to improve the efficiency of European research capabilities.

Both from a theoretical and empirical point of view, there is a broad recognition among economists and policy-makers of the impact of human capital, R&D, technological progress and innovation on productivity and economic growth. Work recently carried out for the European Commission suggests that one additional year of schooling can increase the aggregate productivity by 6.2% for a typical European country (European Commission, 2002). Countries where R&D expenditure by the business sector in relation to GDP has increased most from the 1980s to the 1990s have typically experienced the largest increase in the growth of multi-factor productivity (MFP) (OECD, 2001b).

Europe is, however still under-investing in knowledge and skills. The EU-25 is still lagging far behind the US and Japan in R&D investment and the exploitation of technological innovations, and in many domains the gap is still widening. If we are to consolidate economic recovery and enhance long-term competitiveness, efforts should therefore be maintained and increased.

5. EVIDENCE AND PROGRESS OF THE KNOWLEDGE ECONOMY

All Member States except Sweden registered a declining growth rate in this period compared with 1995-2000. In Germany, investment growth even became negative in 2001. The relative position of countries remains more or less unchanged since the mid-nineties. One can broadly distinguish three groups within the EU-15 in terms of efforts made to speed up the transition to the knowledge-based economy.

The data go up to 2001 and show the recent progress made by the EU-15. In the United States, investment in knowledge, the sum of investment in R&D, software and higher education - amounted to almost 7% of GDP in 2000, well above the share for the European Union or Japan. The OECD average was about 4.8% of GDP, of which almost half for R&D. In most OECD countries, investment in knowledge has grown more rapidly than investment in fixed assets; the United States, Canada and Australia are the major exceptions.

In 2001, OECD countries allocated about USD 645 billion (accounted with PPP, current purchasing power parity) to R&D. The United States accounted for approximately 44 % of the OECD total, the European Union for 28 % and Japan for 17%. R&D expenditure in the OECD area rose annually by 4.7 % over 1995-2001. R&D expenditure has risen faster in the United States (5.4 % a year) than in the European Union (3.7 %) and Japan (2.8 %). In 2001, the R&D intensity of the European Union reached 1.9% of GDP, its highest level since 1991, still well below the Lisbon target of 3 % in 2010. In 2001, Sweden, Finland, Japan and Iceland were the only OECD countries in which the R&D to GDP ratio exceeded 3 %.

During the second half of the 1990s, the share of business funding of R&D increased significantly in the United States, moderately in Japan and only

slightly in the European Union. R&D expenditure by the higher education sector increased in the first half of the 1990s and then stabilized. R&D by the government sector has declined in recent years, partly owing to the reduction in defense R&D and the transfer of some public agencies to the private sector.

In 2000, services accounted for about 23% of total business sector R&D in the OECD area, an increase of 8 percentage points from 1991. More than 30% of all R&D is carried out in the services sector in Norway, Denmark, Australia, Spain and the United States but less than 10% in Germany and Japan. High-technology industries accounted for more than 52% of total manufacturing R&D in 2000, ranging from over 60% in the United States to 47% and 44% in the European Union and Japan, respectively.

Greece, Portugal, Spain and Italy were still lagging behind in 2001. These four countries had an investment level below EU average and a growth of investment comparable to the average growth in 2000-2001 (Greece being slightly above average in terms of investment growth). However, compared to the second half of the nineties, their catching up with the rest of Europe appeared to have slowed down in 2001.

A second group consisting of France, United Kingdom, Germany, Austria, Ireland, Belgium and the Netherlands occupied an average position in terms of both their investment level and growth in 2001, although the cohesion of this group is less obvious than during 1995-2000 period.

Turning to the EU performance in the knowledge-based economy growth was also lower, but the slowdown was less pronounced than for investment. While EU growth in 2001 was positive, its progress was not as fast as in the second half of the 1990s. This deceleration in performance growth occurred for all EU countries except the United Kingdom, The Netherlands and Greece. Greece had a relatively high growth rate in all fields of the performance indicator in 2000-2001. The United Kingdom's improved growth was due to a relatively high growth in overall productivity (GDP/hour worked) whereas the Netherlands showed a high growth in technological performance (patents).

Two broad groups can be distinguished within the EU-15. Portugal, Spain, Greece and Italy were below the EU average. Greece and Spain improved their positions, but Italy and Portugal registered a decline in their performance level in 2001. The second group, consisting of the remaining 10 EU countries was slightly above-average in terms of performance level (especially Sweden and Finland) in 2001 and around average in terms of growth rate. During the period in question Ireland caught up with the European average.

In terms of performance in the knowledge-based economy, the Acceding and Candidate countries were all below the EU-15 average performance level in 2001. This was especially pronounced for technological performance (patents). When one looks only at scientific performance or overall productivity growth, the picture was less negative for these countries, although they were still far below the average EU level.

In 2000-2001, Bulgaria recorded below-EU-average growth rates for all the sub-indicators of the performance indicator, whereas Turkey had a low growth of overall productivity. Estonia and Cyprus recorded under-average growth rates in scientific and technological performance, but had an average growth of overall productivity. Slovenia had above-average growth in technological performance in 2000-2001, but underscored notably in scientific performance.

In 2001, 8.4% of the EU-15's value added originated from high-tech and medium high-tech industries, while for the EU-25 the figure was marginally lower. Ireland is at the top of the group, with almost twice the level of the next country - Malta. It is also interesting to note that among the top performing countries there are both countries with a high overall share of manufacturing in their economic base (Germany, Hungary, Czech Republic).

In EU-15, about 972 500 researchers were employed in the year 2000. This number has shown an average annual growth rate of 3.9% since 1996. In the enlarged EU with 25 Member States, the number will be 110 000 higher, but still about 175 000 lower than the US. Japan is on a similar level to Germany, France, the UK and Spain grouped together. Poland is the largest employer among the new Member States; the other acceding countries each employ between 300 and 15 000 researchers.

Whereas in EU-15 about 50% of researchers are employed by the private sector and in EU-25 even less, this share increases to about 64% for Japan and about 80% for the US. In Europe, only Ireland has a similar share to Japan, and only Austria, Sweden and Switzerland are above 60%. The higher education sector is the most important employer for researchers in Spain, Portugal, Hungary, Poland, Slovakia and Turkey.

The EU-15 as a whole had a lower level of overall investment in the knowledge-based economy in 2001 than the US and Japan. The decrease in investment growth during the 2000-2001 was much stronger for the US than for the EU-15 or Japan. The fall in investment growth for both the US and Japan was due mainly to a sharp decrease in capital formation in 2000-2001. In addition, the US also recorded lower growth than EU-15 in the number of researchers. However, the growth of US research spending was close to that of the EU.

The composite indicator of performance in the knowledge-based economy was lower for EU-15 than for the US in 2001, although Germany's position was marginally above that of the US. More specifically, the US still had a higher level of technological performance than the EU-15, whereas overall productivity and scientific performance in 2001 were very close to the EU level. In terms of performance growth, one can observe a similar small decrease in both the EU and the US.

The interest in the contribution of R&D and human resources to the growth and creation of a knowledge-based economy has reached new heights in the EU in recent years. Today, it is widely agreed that research and technological advancement together with the availability of a highly skilled workforce are among the key factors for innovation, competitiveness and socio-economic welfare. Likewise, the capacity to exploit knowledge has become a crucial element for the production of goods and services.

In 2000, the Lisbon European Council agreed upon the objective to make Europe the most competitive and dynamic knowledge based economy in the world. To reach the objective, the Barcelona Council in March 2002 set the specific target to increase the average level of R&D expenditure in the

EU from 1.9% of GDP to 3% by 2010, of which two thirds should be funded by the private sector.

By 2003, most Member States had taken action to boost R&D investment and set national targets in line with the 3% objective. In April 2003, the Commission adopted a strategic Action Plan («Investing in research»; COM (2003) 226) for accelerating progress towards the goal set by the Barcelona Council. The objectives and plans are challenging, among other reasons because of the economic difficulties experienced in Europe. Economic growth in the euro region slowed down in 2002 and stagnated in the first half of 2003.

In EU-15, every research post was funded by an average of 171,000 euro in 2001. This is lower than both the US average (182,000 euro) and the Japanese average (212,000 euro). After the enlargement, the new EU-25 will have an average of 156,000 euro. In EU-15, the R&D expenditure per researcher varies between 225,000 euro in the Business Enterprise Sector (BES) and 103,000 euro in the Higher Education Sector (HES). The Governmental institutions are at the average of all sectors. Sweden is the EU Member State which spent the largest amount of money per researcher with 227,000 euro, followed by Germany (199,000 euro). In the rest of Europe, Switzerland was highest with 266,000 euro. Bulgaria, Poland and the Baltic States, all below 15,000 euro, were lowest.

Figures on investment are derived from the data on gross domestic expenditure on R&D (GERD). It provides an overall picture of the level of commitment to the creation of new knowledge and to the exploitation of research results in different countries. The volume of R&D investment is a proxy for countries' innovation capacity, and reflects the magnitude of both accumulation and application of new knowledge.

TABLE 3: R&D EXPENDITURE (in 1000 current €) PER RESEARCHER (FTE), 2001

	Totals	Business Enterprise	Higher Education	Government
Belgium	153	201	90	127
Denmark	188	254	121	132
Germany	199	236	121	186
Greece	54	101	38	86
Spain	78	172	41	74
France	180	239	94	205
Ireland	139	151	111	130
Italy	188	239	150	165
Netherlands	186	223	145	170
Austria	180	183	168	228
Portugal	58	121	41	59
Finland	125	156	76	103
Sweden	227	291	128	132
UK	145	164	92	214
Cyprus	81	67	47	140
Czech Rep.	55	87	31	41
Estonia	14	30	11	15
Hungary	37	54	24	30
Lithuania	9	55	5	12
Latvia	10	15	7	13
Poland	23	49	12	39
Slovenia	76	131	40	57
Slovakia	16	45	3	15
Bulgaria	8	13	4	8
Romania	9	10	7	9
Turkey	60	125	50	35
Iceland	140	180	95	123
Norway	154	165	137	144
Switzerland	266	312	171	222
US	182	169	171	361
Japan	212	245	103	404

Source: DG Research, Key Figures 2003-2004 and OECD, MSTI 2003/Vol.1, for non-OECD members: Eurostat/Member States

The «R&D intensity indicator compares countries» R&D expenditure with their gross domestic product. It also facilitates comparisons of the R&D activities between countries. R&D expenditure broken down by main sources of funds reveals information on the structure of financing and the relative importance of different sources in the national R&D system. The section also deals with the role of government in R&D financing, and expenditure on basic research.

In terms of the absolute volume of R&D investment compared to the three economic blocks (EU-15, US, Japan), both the EFTA countries (€10bn; PPS 7bn, in 2001) and the 13 Acceding and Candidate countries (€5bn; PPS 9bn) are comparatively small investors. For instance, the 10 Acceding countries only spent an amount equivalent to less than 2% of the total EU-15 investment in research in current terms. In addition, in the period 1998-2001, the real growth rate recorded for the Acceding countries (16%) was less than one percentage point higher than that of the EU-15. Despite the recent favourable development in the EU-15, the R&D investment gap between the EU and the US has continued to increase in favour of the US. In 2001, the gap was PPS 87bn in real terms, and €141bn in current terms.

Between 1997 and 2001, the growth rate was higher in the small economies and amongst the catching-up countries with relatively low absolute volumes of R&D activities and R&D intensities. The highest growth rates were recorded, in the EU, in Greece (17% per year), Finland (9%) and Sweden (8%), in EFTA, in Iceland (14%), and in the Acceding and Candidate countries, in Estonia (13%), Hungary (12%), Turkey (11%) and Cyprus (10%). The figure recorded for Israel was also exceptionally high (14%). At the opposite end of the scale, the figure for Switzerland (1.3% per year) was the lowest. Only three of the countries, Bulgaria, Romania and Slovakia (each with negative growth rates) were ranked below Switzerland.

TABLE 4: R&D EXPENDITURE BY MAIN SOURCES OF FUNDS (%), 2001

Countries	Business Enterprise	Government	Other National Sources	Abroad
Denmark	58.0	32.6	3.5	5.3
Germany	66.0	31.5	0.4	2.1
Greece	24.2	48.7	2.5	24.7
Spain	47.2	39.9	5.3	7.7
France	52.5	38.7	1.6	7.2
Ireland	66.0	22.6	2.6	8.9
Italy	43.0	50.8	-	6.2
Netherlands	50.1	35.9	2.6	11.4
Austria	39.0	42.1	0.3	18.6
Portugal	32.4	61.2	2.1	4.4
Finland	70.8	25.5	1.2	2.5
Sweden	71.9	21.0	3.8	3.4
UK	46.2	30.2	5.7	18.0
Cyprus	17.5	66.5	6.5	9.4
Czech Rep.	52.5	43.6	1.7	2.2
Estonia	24.2	59.2	3.9	12.7
Hungary	34.8	53.6	0.4	9.2
Latvia	29.4	41.5	na	29.1
Poland	30.8	64.8	2.0	2.4
Slovenia	54.7	37.1	1.1	7.2
Slovakia	56.1	41.3	0.8	1.9

Source: DG Research: Key Figures 2003-2004

In 2001, R&D intensity of the EU-15 reached a record figure of 1.98 %. In spite of this achievement - the highest figure recorded ever for the EU-15 - the EU average was lagging well behind the intensity of the US and Japan and even more so than ever before. The gap was over 0.8 percentage points below the value for the US and 1.1 percentage points behind Japan. If we take into account the 10 Acceding countries, R&D intensity for the EU-25 in 2001 comes out slightly lower (1.93%) than that of the EU-15. The small difference between the figures was due to the fact that the combined volumes of both

GDP and R&D expenditure in the Acceding countries are very low compared to those of the EU-15.

The share of basic research in total R&D expenditure shows considerable variation between countries. The share of basic research is highest in three Acceding countries: the Czech Republic (40%), Poland (38%), and Hungary (29%). The share recorded for Switzerland was also comparatively high, 28%. Within the EU-15, Portugal's figure was the highest, followed at some distance by France, Denmark and Italy, all these in the range 22-28%. While the figure for the US was also above 20%, the share of basic research in total R&D was very low in Japan, at only 12%.

Since 1997, the share of R&D expenditures allocated to basic research, which reflects the relative importance of basic research for R&D and innovation activities, has increased significantly in many countries. For instance, in the period 1997-2001, in the US, expenditure on basic research grew in real terms by almost 50%, while total R&D spending increased at the same time by less than 24%. The growth rate of expenditure on basic research was also clearly higher than that of total R&D expenditure in the Czech Republic, France and Poland. On the other hand, the rate of growth of expenditure on basic research has been clearly lower than that of the total R&D spending in certain countries such as Spain and Portugal.

In terms of expenditure on basic research as a percentage of GDP, Switzerland (0.7%), the US (0.6%), and the Czech Republic (0.5%) put more emphasis on basic research than others. At the other end of the scale, figures recorded for Spain, Slovakia, Portugal, Hungary and the Netherlands were all very low, below 0.2%.

A key determinant of the future competitiveness of an economy is the level and intensity of overall expenditure on R&D. But it is also important to look at the sectors in which this R&D is performed. The business sector is probably most important in this regard. It is closest to consumers and best positioned to significantly improve or develop new products based upon new combinations of existing knowledge or knowledge newly developed through research in-house or elsewhere and to commercialize them.

In the mid-1990s, the EU-15 took over from the US as being the largest producer of scientific literature in absolute terms as well as in world share. By the end of the century, the gap between the EU-15 and the US had grown to more than six percentage points in favour of the EU-15. In 2001 Europe had to face a small decline of its share, although total publication numbers were still growing. From 2001 to however, the situation deteriorated for the EU-15 in terms of share (-2.1%), and its total number of publications also fell. With high growth rates during the latter half of the 1990s, the situation was similar for Japan. However, in terms of publication share Japan experienced a small loss in 2002 (-1.2%) but still managed to increase its total publication numbers.

TABLE 5: RELATIVE ACTIVITY INDEX (RAI) BY EU-15, 1996-1999.

	Engineering	Physics, Astrophysics Astronomy	Mathe-matics, Statistics & Computer Sciences	Chemistry	Earth & Environmental Sciences	Life Sciences
Greece	+		+		+	
Poland		+		+		
Bulgaria		+		+		
Latvia		+		+		
Italy		+				
Slovenia	+			+		
Cyprus						
Tu rkey	+					
Germany		+		+		
Russia		+		+		
Estonia		+			+	
Slovakia				+		
Spain				+		
Czech Republic				+		
France						
Japan+			+			
Israel						
UK						
US						

Austria						
Switzer.						
Denmark					+	
Belgium						
Norway					+	+
Ireland						
Iceland					+	+
Finland						+
Sweden						+

Source: DG Research, Key Figures 2003-2004.

The situation has certainly improved for the US. While the US suffered from diminishing publication numbers and shares during the late 1990s, it has managed to grow in both categories since 2000. It may be too early to speculate about changes in trends, however, the capabilities of the US in terms of scientific production should not be underestimated. While the current EU-15 decrease is still minor, it may well foreshadow something worse and result from a relative decline in R&D investment in the EU-15 during the 1990s. Table 6 shows the activities, in terms of scientific publications, in 27 countries of the European Research Area as well as important competitors and partners. It shows the relative specialization of each country in six main science and technology fields.

Business expenditure on R&D (BERD) accounted for most of total domestic R&D expenditure (GERD) in Japan (73.7%), the US (72.9%), the EU-15 (65.6%) and the EU-25 (65.3%). The shares for both the EU-15 and the EU-25 are quite high, but substantially lower than the US and Japanese shares. However, growth rates for the period 1997-2001 of 0.9 % for the EU-15 and 0.8 % for the EU-25, as compared to -0.3 % for the US and 0.6 % for Japan, point to possible convergence in the future. There exists substantial diversity among EU Member States. Greece (28.5%) and Portugal (40.5%) remain quite far below the 50% level, while Italy (50.1%) and Spain (52.4%) find themselves at levels only just above the 50% level. On the other hand, the UK (67.4%), Ireland (68.5%), Germany (70.0%), Finland (71.1%) and Belgium (71.6%) are closer to the US, and Sweden (77.6%) even higher than Japan. With the exception of Slovakia (67.3%), none of the Acceding and Candidate countries have values higher than those for the EU-

25, the EU-15, the US or Japan. And only Slovakia, Romania (61.6%), the Czech Republic (60.2%) and Slovenia (57.8%) exceed the 50% level.

TABLE 6: R&D EXPENDITURE OF TOP 300 INTERNATIONAL BUSINESS R&D SPENDERS BY TRADE ZONE

	Number of firms	% of total R&D		Average annual growth rate of R&D investment %	Average annual growth rate of R&D investment %
	2002	1998	2002	1998-2002	1998-2002
US	127	42.8	40.9	3.1	-12.6
Japan	73	22.7	21.7	3.2	4.0
Belgium	-----	0.1	0.2	19.3	16.1
Denmark	2	0.2	0.3	11.2	9.0
Finland	1	0.6	1.3	24.5	24.5
France	22	5.9	6.8	8.2	0.0
Germany	24	11.9	12.4	5.4	19.5
Ireland	1	0.6	0.1	-27.4	-10.0
Italy	3	1.2	1.1	1.4	2.9
Sweden	5	2.1	1.7	-1.0	-16.8
Netherlands	6	1.4	2.5	19.5	3.2
UK	15	4.1	5.0	9.5	0.3
Other countries	19	6.3	6.1	3.5	14.0
Total	300	100	100	4.3	-2.2

Source: DG Research, Key Figures 2003-2004

Data on patents with foreign co-inventors provide an indication of the extent to which countries co-operate internationally in inventive activities. To some extent such cooperation is a function of country size, with smaller countries tending to engage more often in foreign collaboration. Thus, one sees Luxembourg with 57% of its patents involving foreign co-inventors, followed by Belgium and Ireland with over 30%. The Czech Republic and Hungary also have quite high rates (31% and 27%). The larger countries tend to have lower rates of overseas collaboration - for example, France has 13% and Germany 10% - although the UK with nearly 20% foreign co-inventors shows a comparatively high degree of internationalization for its size. Taken as a whole, and excluding intra-EU collaborations, the EU-15 has a slightly

lower proportion of foreign co-inventors than the US (7% versus 11%), but is higher than Japan (3%). For most countries the trend since the early 1990s has been towards an increase in foreign co-invention.

6. CONCLUSIONS

This paper presented the situation of the EU present and future members from the perspective of indicators, showing their relative position in respect of the knowledge-based economy as well as their competitive position. It has been argued that in order to make Europe more competitive - or even simply maintain its current competitive position, sustained growth and employment levels - Europe needs to invest in production of new knowledge, in applying new technology, and ultimately in the people that will be able to put the new knowledge and technology to use. The current state of affairs has been described using various indicators of scientific and technological output, as well as general competitiveness indicators.

Looking first at scientific and technological output, the EU is still ahead of the US and Japan in its share of scientific publications, but lags behind in most of the other performance indicators, especially patents. There is, nonetheless, a substantial variation within the EU and certain EU Member States often score better than the US and Japan (most notably Sweden and Finland), yet the overall situation in the EU-15 is far from satisfactory. Moreover, one tends to find most of the Acceding countries in a position of catching up from relatively low levels of S&T output. Although there are some noticeable encouraging tendencies in several Acceding countries, one can expect that with the enlargement of the Union, the «European Paradox» will be, at least temporarily, further accentuated. In other words, in relation to its enlarged population, the EU-25's strong performance in science will contrast increasingly with its weaker development and commercialization of technology.

However, Europe still needs to better exploit its scientific and technological output, notably in terms of selling its high-tech goods on world markets. While its share of high-tech exports has grown slightly since the mid-1990s, the EU still had a lower market share than the US in 2001.

Indeed, 2001 was a difficult year for the high-tech sector, and the ability of industry to withstand this correction will be a crucial factor in a number of countries. Moreover, this is a highly competitive market no longer restricted to the major developed countries. Over the past decade, we have seen developing Asian producers emerge as important players in high-tech market niches. A number of Acceding countries are also growing rapidly in their exports of high-tech, due in part to inflows of foreign investment.

The slowing down of EU-15 investment in the knowledge-based economy is likely to be reflected sooner or later in a significant decline in its performance. This trend underlines the urgency of implementing the Lisbon Strategy. In particular, the EU needs to increase its efforts, so as to give renewed impetus to the catching up of some countries with the rest of the EU-15 and to close the gap as soon as possible with the US.

• In 2000, approximately 3.4 million researchers were engaged in research and development (R&D) in the OECD area. This corresponds to about 6.5 researchers per thousand employees, a significant increase from the 1991 level of 5.6 researchers per thousand.
• Among the major OECD regions, Japan has the highest number of researchers relative to total employment, followed by the United States and the European Union. However, around 38% of all OECD-area researchers reside in the United States, 29% in the European Union and 19% in Japan.
• In 2000, approximately 2.1 million researchers (about 64% of the total) were employed by the business sector in the OECD area.
• In the major economic zones, the share of business researchers in the national total differs widely. In the United States, four out of five researchers work in the business sector but only one out of two in the European Union.
• Finland, the United States, Japan and Sweden are the only countries where business researchers in industry exceed 6 per thousand employees; in the large European economies, they are only 3 or 4 per thousand employees.
• Mexico, Turkey, Portugal, Greece and Poland have a low intensity of business researchers (fewer than 1 per thousand employees in industry). This is mainly due to national characteristics; in these countries, the business sector plays a much smaller role in the national innovation system than the higher education and government sectors. Business sector R&D expenditure in these countries accounts for only 25-35% of total R&D

expenditure.
• Countries in transition in Central and Eastern Europe have been affected by the reduction in numbers of business researchers in the 1990s, although the trend has reversed in the Czech Republic and Hungary in the past few years.

Large investments in education over the past decades have led to a general rise in the educational attainment of the employed population. On average, 28.2% of employed persons in OECD countries have a tertiary-level degree. The United States (36.8%) and Japan (36.5%) rank far ahead of the European Union (24.0%), which also has large cross-country disparities. Employment growth of tertiary-level graduates ranged between 2% and 6% a year over 1997-2001, substantially faster than aggregate employment growth. Unemployment rates are generally much lower for university graduates than for the overall population, although they are higher for women than for men. Professional and technical workers represent between 20% and 35% of total employment in most OECD countries, and over 35% in Sweden, Switzerland, Australia and Denmark.

We can summarize some of the main findings:

• In terms of scientific publications Europe's strong growth seems to have halted. Actual numbers are still rising, but the EU share of world publications is declining, whereas the US share is recovering.
• Per head of population, the EU generates fewer patents with a high economic value (so-called 'Triadic patents') than the US and Japan.
• The EU is lagging behind the US in its share of patents in biotechnology and information and communications technology.
• There has been a slight increase in the EU share of global exports of high-tech products in value terms between 1996 and 2001. Japan's share fell sharply in 2001 hit by falling sales of electronic goods.
• Since the middle of the 1990s, the EU has stopped catching up with the US in terms of labour productivity, reflecting a relatively weaker innovation performance.
• Large disparities persist among EU countries in both high-tech manufacturing and KIS. Japan outperforms the EU in high-tech manufacturing indicators while the Central European Acceding countries

perform better than the EU average.

• The production of scientific research and technological know-how increasingly depends on research conducted in other countries. Indicators of cross-border co-authorship of scientific articles and co-invention of patents seek to shed light on this trend.

• Scientific collaboration with large OECD countries is generally much more widespread than with smaller ones. Researchers in 160 countries co-authored at least 1% of their internationally co-authored papers with US researchers. The United Kingdom, France and Germany also play a leading role in international scientific collaboration.

• By the late 1990s, about 6% of patents of OECD residents were the result of international collaborative research. Several factors may affect the degree of a country's internationalization in science and technology: size, technological endowment, geographical proximity to regions with high research activity, language, industrial specialization, existence of foreign affiliates, etc.

• Internationalization tends to be higher in smaller European countries. For example, 56 % of Luxembourg's patents have foreign co-inventors and 30 % of Iceland's and Belgium's. International cooperation in science and technology is also relatively high in Poland, the Czech Republic and the Slovak Republic.

• When intra-EU co-operation is factored out, international collaboration in patenting is lower in the European Union than in the United States. In Japan, international co-operation in science and technology is rather limited.

REFERENCES

American Association for the Advancement of Science (2003). Long-delayed '03 budget provides historic increases for R&D, *Science and Technology in Congress,* March 2003, 1 & 6-7.

European Commission (2000). Towards a European research area, *Communication from the Commission* COM (2000)6 European Commission, Luxembourg.

European Commission (2001a). A mobility strategy for the European Research Area. *Communication from the Commission* COM (2001) 331, European Commission, Brussels.

European Commission (2001b). *European Competitiveness Report 2001,* European Commission, Brussels.

European Commission (2001c). On implementation of the Risk Capital Action Plan (RCAP). *Communication from the European Commission* COM (2001) 506, European Commission, Brussels.

European Commission (2002). *Human Capital in a global and knowledge-based economy,* European Commission, Brussels.

European Commission (2003). Investing in research: an action plan for Europe, *Communication from the Commission* COM (2003) 226. European Commission, Brussels.

European Commission (2003a). Researchers in the European Research Area: One profession, multiple careers, *Communication from the Commission* COM (2003) 436, European Commission, Brussels.

European Commission (2003b). The role of the universities in the Europe of knowledge, *Communication from the Commission* COM (2003) 58, European Commission, Brussels.

European Commission (2003c). *Employment in Europe,* European Commission, DG Employment, Brussels.

European Commission, (2003d). Choosing to Grow: Knowledge, innovation and jobs in a cohesive society, *Report to the Spring European Council, 21 March 2003 on the Lisbon strategy of Economic, social and environmental renewal* COM (2003) 5, European Commission, Brussels.

European Commission (2003e). *Commission's Paper launching an initiative for growth on 9 July* 2003 SEC (2003)813, European Commission, Brussels.

European Commission (2003f). *Communication from the Commission: An initiative for growth for the European Union through investment in networks and knowledge, Interim Report to the European Council* (26 September, 2003), European Commission, Brussels.

European Commission / DG Research (2003a). *Third European Report on Science and Technology Indicators 2003: Towards a Knowledge-based Economy.* European Commission, Brussels.

European Commission / DG Research (2003b). *"She Figures" Women and Science Statistics and Indicators,* European Commission, Brussels.

European Commission / DG Research. Key Figures 2003-2004: Towards a European Research Area Science, Technology and Innovation 2004.

European Council (2003). *Presidency Conclusions of the Thessaloniki European Council, 19 and 20 June 2003,* European Council, Brussels.

European Science Foundation (2003). New structures for the support of high-quality research in Europe, *An ESF Position Paper,* April 2003.

Eurostat (2002a). *Research and development: annual statistics, data 1990-2000,* Eurostat, Luxembourg.

Eurostat (2002b). *Science and technology in Europe, Statistical pocketbook, data 1990-2000* (2002), Eurostat, Luxembourg.

Main Science and Technology Indicators 2003-1 (2003). OECD, Paris.

Ministry of Education and Science (2000). *A summary of Government Bill "Research and Renewal"*, 2000/01:3, Ministry of Education and Science, Stockholm.

Ministry of Education, Culture, Sports, Science and Technology of Japan (2002). Science and Technology Basic Plan, <*http://mext.go.jp/english/org/science*>.

National Science Foundation (2002). *National Science Board, Science and engineering indicators 2002,* Vol. 1, National Science Foundation, Arlington, VA.

OECD (1994). Canberra Manual, Manual on the Measurement of Human Resources Devoted to S&T, OECD, Paris.

OECD (1997). Revision of the High-technology Sector and Product Classification (1997), *STI Working Papers* 2/1997, OECD, Paris.

OECD (2001a). Basic research: statistical issues. OECD/NESTI Document DSTI/EAS/STP/NESTI (2001) 38. OECD, Paris.

OECD (2001b). *The new economy: beyond the hype,* Final report on the OECD growth project. Meeting of the OECD Council at ministerial level, 2001, OECD, Paris.

OECD (2002a). Frascati Manual, Proposed standards practice for surveys on research and experimental development, OECD, Paris.

OECD (2002b). Public funding of R&D - trends and changes, OECD Document DSTI/STP (2002)3/REV1 prepared by the ad hoc working group on «Steering and Funding of Research Institutions», OECD, Paris.

The Cyprus Journal of Sciences, Vol. 3, 2005/167-189

A HOLISTIC INTEGRATION FRAMEWORK OF INFORMATION & COMMUNICATION TECHNOLOGIES (ICT) IN HOSPITALITY OPERATION PROCESSES

MARIANNA SIGALA*

ABSTRACT

In search of competitive advantage and value-added strategies, companies are increasingly investing on Information & Communication Technologies (ICT), but research has failed to provide rigid evidence regarding the ICT performance impact. The hospitality industry is faced with similar problems. This study aims to investigate the ICT-performance relation by critically reviewing previous studies on the ICT productivity paradox. Findings suggest a direct link between ICT and hospitality operations provided that the latter are socio-technically linked. Discussions are summarized into a holistic and balanced framework that integrates ICT applications with hospitality operations and identifies the structural, social/historical, power/political and cultural issues influencing the materialisation of ICT benefits.

Keywords: ICT, benefits, integration, holistic framework, operations, hospitality

1. INTRODUCTION

Increasing competition leads organizations to search for more effective business strategies. Many of these have turned to Information & Communication Technologies (ICT) as a way to cope with turbulent environments. Indeed, over the last decade, ICT investments in tourism and hospitality have greatly increasing. However, studies investigating the ICT productivity impact have always led to contradictory and/or questionable results regarding the ICT benefits on firm performance and productivity. Robert Solow, a Nobel winning economist, is supposed to have said that, *"PCs are showing up all over the place, except in productivity statistics"*, (in Lucas,

* Lecturer, Operations and Production Management, Department of Business Administration, University of the Aegean, Greece

1993, p. 8), while Brynjolfsson (1993) first referred to the "IT productivity paradox" to highlight that the benefits of ICT spending have not shown up in aggregate output statistics. Nevertheless, as past studies have been critized on several methodological shortcomings (e.g. Brynjolfsson, 1993; Shafer and Byrd, 2000), new methodologies for evaluating ICT investments and measuring their performance impact are required.

Recently, the ICT productivity paradox has also boosted research within the hospitality industry and so, the aim of this paper is threefold: a) critically review the methodological problems in measuring the ICT performance impact; this analysis can significantly help hotel managers taking robust decisions in the evaluation of ICT investments; b) analyze the methodology and findings of research undertaken for unraveling the ICT productivity paradox in the hospitality sector; this discussion clearly shows the direct link of ICT investments with operational and strategic performance benefits as well as provides a roadmap for aligning ICT applications with hospitality processes; and, c) present a holistic framework for integrating ICT applications within hospitality organizations; this framework consists a valuable blueprint and balanced framework for identifying structural, social/historical, power/political and cultural issues that impact on the materialization of ICT benefits.

2. THE ICT PRODUCTIVITY PARADOX: A METHODOLOGICAL ARTIFACT?

The seemingly obvious yet elusive relationship between ICT and productivity has accumulated a great body of research (e.g. Brynjolfsson, 1993; Hitt and Brynjolfsson, 1996; Lucas, 1993) exploring the ICT productivity impact on four levels – economy, industry, firm and process. However, research findings are plagued with ambiguities and inconsistencies. Some researchers reported no relationship between ICT and productivity (e.g. Strassmann 1990; Dos Santos et al., 1993; Byrd and Marshall, 1997), some others provided evidence of such relationship (e.g. Bender, 1986; Brynjolfsson, 1993; Roach, 1988). Few studies have shown negative or dysfunctional ICT productivity effects (e.g. Weill, 1992). Nevertheless, as studies have been questioned on methodological grounds, research findings are claimed to be statistical artifacts. The following methodological issues affecting research

quality of studies investigating the ICT-productivity relation are reported as follows.

2.1. The quality of the data used and analyzed.

A few studies relied on questionable secondary data (e.g. data of Computerworld), while others did not control for contextual factors (Byrd and Marshall, 1997). Others (Cron and Sobol, 1983; Strassmann, 1990) suggested that ICT have an amplifier effect meaning that the introduction of ICT into poorly run firms does not increase productivity, whereas the ICT introduction into well-run firms pay-off. Thus, research that simply incorporated ICT as an input factor of productivity functions did not consider this issue. Overall, the amplifier effect requires good organizational management as well as effective integration of ICT applications in business process that might also entail business process reengineering and/or restructuring. The latter is very important since many hospitality managers perceive that ICT should have a *"plug and play"* effect on business performance.

2.2. The metrics measuring productivity.

There is a misconception that productivity metrics cannot capture the full impact of ICT (e.g. quality increases, avoidance of competitive disadvantage). However, it is argued (e.g. Gummeson, 1998; Ball, 1993) that financial metrics encapsulate both tangible and intangible productivity gains, because only when tangibles and intangibles are as they should be, will customer levels, income and costs be controlled in such a way that profit is produced at the required rate in relation to the capital employed. Jurison (1996) also claimed that the ICT productivity paradox is due to bad management and not mismeasurement of productivity benefits, meaning that firms fail to translate intermediate ICT benefits (e.g. better customer service) into final outcomes (e.g. charge higher prices). Another concern refers to the level of analysis and productivity measurement. Aggregated inputs/outputs metrics obscure information, while partial metrics hide trade-offs and complementarities among other dimensions (e.g. business departments, resources). To address this, partial metrics may be considered simultaneously, but this is very laborious and may lead to conflicting results (Baker and Riley, 1994).

2.3. The metrics measuring ICT.

ICT budgets and expenditures are the most frequently used metrics of computerization, as they are readily available and reasonably objective, but their reliability and validity are widely criticized, as they do not distinguish between different ICT tools, capabilities and applications. They do however provide different results and benefits (Willcocks et al., 1998; Lucas, 1993; Strassmann, 1990). In short, ICT budgets fail to illustrate how ICT provide business benefits. However, recent studies (Bresnahan et al., 2002; Brynjolfsson et al., 2000) showed that ICT productivity benefits accrue only when ICT are embedded in a cluster of organizational changes that include: increased ICT use; changes in organizational practices; and product/services changes. Within tourism and hospitality, it is clear that ICT provide value when ICT are used to: redefine, differentiate and informationalize product/services; streamline, rationalize and support processes. Financial metrics for benchmarking ICT benefits across firms also suffer from: fluctuations of ICT budgets over time (ICT budgets depend on the firms' accumulated ICT assets and ICT costs which are decreasing); waste of ICT expenses; different ways of financing e.g. outsourcing) and different classifications for measuring/reporting ICT expenditures.

2.4. Level of analysis at which research is undertaken.

This refers to the measurement level of both productivity and ICT. Studies measuring productivity at the economy and industry level are limited because macro data do not capture firm level phenomena and hide displacement effects (Brynjolfsson, 1993). Menon (2000) argued that the organizational is the best level of analysis, as it captures substitution, synergy and complementarities between resources. However, recent studies advocate that research on the ICT benefits should immigrate from firm-level to process-level studies. This is because aggregate data used in firm-level studies tend to hide and balance trade offs and substitution effects amongst processes. On the contrary, process-centric approaches gather the first-order impact of ICT that occurs at the process level by improving individual business processes and /or enabling inter-processes linkages. Consequently, the greater the impact of ICT on individual processes and on inter-processes linkages, the greater the ICT business value. Moreover, as past studies on the ICT productivity paradox have

ignored soft and intermediate benefits such as inventory management and enhanced customer service, current research should apply a more comprehensive and inclusive approach to the measurement of CRM applications benefits that includes broader economic and strategic impacts.

2.5. Statistical method relating ICT with productivity.

The majority of studies have used regression and ratio analysis, but these can simultaneously only consider a limited number of variables. For example a productivity metric, "revenue to number of employees", does not consider other factors of production, while aggregate productivity metrics (e.g. total revenue to total expenses) do not distinguish the productivity impact of different inputs/outputs. Regression is also limited in investigating the effect of one input (or output) to multiple outputs (or inputs). These techniques also assume away production inefficiency, which production functions model. Production functions also consider multiple inputs and outputs simultaneously, but being parametric techniques, i.e. assuming a functional form for the technology transforming inputs into outputs, they can suffer from specification error. Because of that, a non-parametric, multivariate technique called Data Envelopment Analysis (DEA) is increasingly used in ICT-productivity studies. DEA benchmarks units by comparing their ratios of multiple inputs to produce multiple outputs at the same time and by using the concept of the performance frontier (Avkiran, 1999). DEA shares the advantages of production functions, but it is specification error free because it does not assume a functional form. Instead, DEA estimates a "best practice" frontier in a piecewise linear approach by comparing similar units from the dataset. Other DEA's advantages are (Sengupta, 1988; Banker and Morey, 1986): identification of bad from good performers by generating an overall, easy to interpret efficiency score; independence measurement units (giving great flexibility in selecting outputs/inputs); manipulation of uncontrollable, environmental factors, e.g. competition. Avkiran (1999) highlighted that failure to account for environmental factors is likely to confound DEA results and lead to unreliable analysis. Norman and Stoker (1991) argued that DEA models not including demand factors measure production efficiency, while models including them reflect market efficiency, i.e. ability to control production efficiency given demand factors.

DEA has been extensively used for productivity measurement in various industries (e.g. Avkiran, 1999), as well as for assessing the ICT productivity impact (Paradi et al., 1997; Dasgupta et al., 1999; Shafer & Byrd, 2000; Banker et al., 1990). However, the latter DEA studies present several caveats: ICT budgets / costs and single-aggregated productivity inputs/outputs are used; the ICT amplifier effect and the productivity impact of contextual factors are not examined. The proposed methodology contributes to the body of knowledge by developing: a) a DEA model for assessing the ICT productivity impact that overcomes the previous limitations and isolates the impact of contextual factors; b) a stepwise DEA approach for constructing robust DEA productivity models.

3. A REALITY CHECK INTO THE ICT PRODUCTIVITY PARADOX IN THE HOSPITALITY INDUSTRY

Based on the previous discussion and the presentation and critical evaluation of three recently conducted studies investigating the ICT productivity paradox in the hospitality industry, this section aims to propose and justify the development of an integrated ICT framework for materializing ICT benefits. Analytically, in order to eliminate the impact on the ICT-productivity relation of several contextual factors, the first study (Sigala, 2003a) aimed to assess the ICT productivity impact in the three star hotel sector by gathering data from the UK industry. To overcome previous methodological limitations the following procedure was followed. The ICT productivity impact was investigated at the hotel property level to overcome the limitations of higher level studies. However, hotel productivity was measured at two divisions, i.e. Rooms and Food & Beverage division in order to gather more reliable data and avoid the limitations of aggregated firm level data. Financial, objective and easily obtainable productivity inputs and outputs were gathered for encapsulating both tangible and intangible ICT impacts. Data regarding potential contextual/environmental factors that could have affected productivity (e.g. demand variability, markets served) were also gathered. To simultaneously consider multiple productivity inputs/outputs/factors, the DEA technique was applied by using the statistical package Frontier Analyst. By using DEA, bad and good performers were identified and so the ICT amplifier effect was considered. However, because the quality and reliability of DEA are

as good as its inputs/outputs/factors, a stepwise data analysis procedure was also used for selecting appropriate productivity inputs and outputs metrics and constructing robust DEA productivity models. This is an iterative procedure in which productivity is measured based on the important factors identified up to that step. Other important factors are identified by examining factors that correlate with the productivity metric and applying judgments in terms of cause and effect. These factors are incorporated into DEA and the process is repeated until no further important factors emerge. At that stage a robust productivity metric accounting for all the identifiable factors influencing productivity is constructed. Specifically, because aggregated metrics may obscure information, the first step of DEA used aggregated input/output metrics, which were later disaggregated into their constituent parts (partial metrics) when the latter are found to significantly affect productivity scores (i.e. significant Pearson correlations, $\alpha=0.05$, between DEA scores and partial metrics).

To consider previous arguments regarding the limitations of using ICT budgets and consider the fact that it is actually the ICT deployment and use that drives performance, the ICT investments were measured by using three metrics: 1) number and type of available ICT systems; 2) integration of ICT applications with Property Management Systems (PMS, i.e. the digital nervous system of hotel ICT applications) and amongst each other; and 3) sophistication of use of critical success (CS) ICT, including PMS, Website, e-mail, Intranet, Extranet and customer data warehouse (Table 1). ICT integration greatly increases operational efficiencies, as it eliminates manual re-entry of data (automation impacts), facilitates easy retrieval, sharing and search of consolidated databases (informate impacts), which are vital for informationalizing product/services and streamlining, reengineering processes (transformate impacts) (Sigala et al., 2001b; Willcocks et al., 1998; Sigala et al., 2001a). Thus, exploitation of CS ICT was measured by developing a number of ICT activities reflecting automational, informational and transformation utilization. As different ICT activities result in different benefits, activities were weighted (1, 3 or 5) and load factors instead of number of activities were summed for calculating the ICT exploitation sophistication score of each CS ICT.

TABLE 1: SOPHISTICATION OF EXPLOITATION OF CRITICAL SUCCESS ICT (% of respondents)

PMS		**Website**	
Automate front office operations (1)	96.2	Information provision (1)	96.6
Automate back office operations (1)	88.5	Links to other sites (1)	63.6
Communicate & share information (3)	44.9	Online bookings (3)	30.7
Collect and store data (3)	71.8	Customer communications (3)	64.8
Analyze data &/or produce reports (5)	65.4	Collect customer information (5)	34.1
Platform enabling other applications (5)	50.0	Provide customized content (5)	18.2

	Email	**Intranet**	**Extranet**
Automate front office operations (1)	n.a.	20.0	0.00
Automate back office operations (1)	n.a.	20.0	0.00
Store information (1)	n.a.	70.0	0.00
Make room reservations & bookings (3)	81.3	36.7	40.0
Conduct transactions with suppliers (3)	29.7	20.0	20.0
Enable internal communication (5)	38.5	76.7	0.00
Enable external communication (5)	52.7	26.7	60.0

Customer data warehouse	
Automate tasks of front and/or back office staff (1)	59.7
Automate tasks of sales and marketing staff (1)	61.2
Enable staff of different departments to access customer information (3)	44.8
Develop personal customized promotions and/or sales offers (3)	76.1
Deliver Customer Relationship Management activities (5)	22.4
Plan the hotel strategy (5)	29.9

Source: Sigala (2003)

Table 2 provides data regarding the implementation of the stepwise DEA process for developing a robust productivity metric in the rooms division. It is clear that at step 4 the initial aggregated productivity metrics have been disaggregated into the most statistically important factors that affect rooms' division productivity in the sample. In this vein, the ability of ICT to affect these metrics could have a significant effect on rooms' division productivity.

However, findings revealed that ICT availability, i.e., the number of ICT applications available do not have a substantial impact on ICT productivity. On the contrary, the impact of ICT availability becomes apparent only when an ICT integration productivity impact is found. For example, the availability of any F&B ICT does not affect F&B productivity. However, hotels having F&B ICT integrated with PMS had significantly higher hotel property operational productivity levels. This indicates that PMS – F&B ICT integration is vital for materializing benefits, as it enables synergies and co-ordination among hotel divisions, e.g. F&B managers can better schedule operations when having information regarding hotel occupancy and guests' patterns of hotel restaurant use. Videoconferencing systems are another example of synergy effects. Their availability can significantly enhance FB and hotel productivity overall as hotels can benefit from increased F&B and room sales. Moreover, the post hoc Scheffe tests indicated that the direction of the ICT integration impact was: between ICT holders and holders of integrated ICT; and between holders of integrated ICT and non-ICT holders. As no significant difference between ICT holders and non ICT holders was found, it is concluded that ICT integration is more important for realizing productivity benefits than ICT availability. No significant Pearson correlations amongst number of direct ICT integrations and productivity scores revealed that direct ICT integration are not as important as ICT-PMS integration. (i.e., the best ICT architecture is based on PMS).

Significant positive Pearson correlations and t-tests between CS ICT sophistication scores and RD, FB and hotel operational efficiencies (Table 2) revealed that hotels using PMS and customer database for informational and transformational activities achieved significantly greater productivity scores than those using ICT for automation only. The impact of sophistication of newer ICT, i.e. E-mail, Website and Intranet, is none or minimal, which is not surprising considering the limited and basic use of these ICT by respondents and the limited number of reservations received through Websites. Overall, such findings reveal that the ICT productivity benefits are realized when hotels extend their ICT exploitation for informalizing and re-engineering their products, services, operations and for fostering business innovation. In other words, ICT productivity benefits require a substantial alignment of ICT capabilities with organizational processes and products.

TABLE 2: INPUTS/OUTPUTS/FACTORS INCLUDED IN THE STEPWISE DEA IN THE ROOMS DIVISION

	Step 1 (input min)	**Step 2 (input min)**	**Step 3 (input min)**	**Step 4 (output max)**
Outputs				
Non FB total revenue	*			
ARR		*	*	*
Room nights		*	*	*
Non roomnights revenue		*	*	*
Inputs				
Rooms	*	*	*	*
RD total payroll	*	*		
RD total M&O expenses	*	*		
Front office payroll			*	*
Administration M&O expenses			*	*
Other RD payroll			*	*
Other RD M&O expenses			*	*
Demand variability				*
Other Inputs/Outputs and factors correlated with DEA scores in all steps				
DEA inputs: % of reservations from: property based reservation system, third parties and Internet; length of stay; number of: full time staff; part time staff; IT staff; managers; full time staff in: rooms division; front office, housekeeping, telephone, administration, marketing, minor operations; % of payroll for full time staff; payroll and material & other expenses in: front office, housekeeping, telephone, minor operations, marketing, administration. DEA outputs: % of roomnights from: repeat customers, business, leisure, conference and other; occupancy; ARR; total roomnights; non-FB revenue (revenue from minor operations + revenue from telephone); hotel profit; rooms division revenue; non-rooms division revenue.				

Non FB total revenue refers to all hotel revenue except of revenue obtained from the FB division, i.e. it includes revenue from roomnights, telephone and minor operations.
Non roomnights revenue refers to revenue obtained from telephone and minor operations.
Minor operations include activities such as laundry services, souvenirs sales, that in three star hotel properties occupy staff from the rooms divisions department.
* = indicates that a variable is included in the DEA model
Source: Sigala (2003)

The second study (Sigala, 2003b) aimed to assess the ICT impact on restaurant productivity by overcoming previous methodological limitations. To achieve the latter similar metrics (aggregated and disaggregated financial productivity inputs and outputs) and a similar stepwise DEA process to the previous study was used for producing robust productivity metrics. Regarding ICT measurement, three metrics were used for capturing the level and type of ICT used, namely the number of ICT systems, their systems integration and their type and sophistication of use. In particular, a restaurant process – resource matrix (Table 3) was produced in order to plot the integration of ICT capabilities into restaurant operations and illustrate the alignment of ICT capabilities with business objectives – performance targets. Table 3 is critical since it clearly illustrates how ICT capabilities and tools can be directly linked to restaurant benefits and process restructuring. Research findings revealed similar results, i.e. the ICT productivity paradox is not an ICT problem (an issue of number of ICT systems) but an organisational problem (an issue of integrating ICT systems together and diffusing their use into effective business processes).

TABLE 3: ICT USE FOR RESTAURANT PRODUCTIVITY (MANAGEMENT OF FOUR RESOURCES)

Productivity enhancement method	**Employees**	**Customers/ Demand**	**Space/seats/physical capacity**	**Menu/Invent. items**
Reduce uncertainty of arrivals/ Demand	Forecasting required labor levels (54%)	Forecast demand (68%) Overbooking (54%) Reduce no-shows (43%)	Forecast table availability (23%) Manage reservations (table configuration optimization) (13%)	Forecast raw goods to order (48%) Inventory control (69%) Just-in-time procurement (32%)
Shifting/ managing demand*:** ***Development and management of non-physical and physical fences:	Improve labor scheduling (71%)	Advanced reservations (63%) Duration charges (0%)	Differential pricing for floor/room sections (1%) Differential pricing for consuming space at different times (weekday/rush hours etc) (77%)	Differential pricing for menu items (82%)
Differential / person-alization of pricing and/or experience		Develop guest history systems (9%) Frequent customer programs (0%)		Recipe database and nutritional analysis (0%) Cost accounting and pricing formulation (89%)
Reduce meal duration uncertainty	Improve staff communication (75%) Improve bussing (73%) Speed check delivery (69%) Server-station	Direct customer-order-entry systems (0%)	Track consumption times (4%) Service status-zone conditions (10%) Table-status by meal part (3%)	Menu engineering (67%) Order by table and time (21%) Track food-

	management (42%)			preparation (15%) Track meal duration by meal part (3%)
Reduce time between customers	Buzzer systems (alert staff) (65%) Improve communication (77%)	Buzzer systems (customer paging) (0%)	Table management (9%) Estimate waiting time (1%)	
e-business benefits webification of business processes	e-recruitment (2%) e-training (8%)	e-reservations (3%) e-customer service (4%)	Mutli-channel distribution/ promotion (13%)	e-procurement (6%)
Multi-unit management	Centralized training (23%) Centralized staff scheduling (5%)	IT reservations systems to direct customers to other units (1%) Share of customer databases – histories (1%)	Multi-unit space scheduling (0%)	Centralized procurement (6%)

Source: adopted from Ansel & Dyer (1999) and Sigala (2004a) (% in parenthesis correspond to % of respondents)

The third study (Sigala, 2004b) aimed to investigate the productivity benefits of a specific ICT application that is becoming critical for the hotel industry namely Customer Relationship Management systems. To overcome previous methodological limitations, Sigala (2004b) developed a process-oriented evaluation approach (Figure 1) that also considered the moderation impact on the ICT-productivity relation of two factors namely corporate strategic goals for ICT and ICT management practices (i.e. the process for planning, evaluating, implementing, and controlling ICT applications). Table 4 illustrates how CRM systems can be integrated and impact on hotel business

processes. Previous research (Karimi et al. 2001, Tallon et al. 2000) has also proved that corporate strategic ICT goals have a direct as well as an indirect (by influencing the way organisations plan, invest, use and monitor ICT projects) impact on ICT benefits. Overall, this study controlled for the effects of any ICT goals by classifying firms as: 1) market focused firms aiming to exploit ICT for creating or enhancing the value proposition to their customers; 2) operations focused firms aiming to exploit ICT for reducing operating costs and enhancing the overall effectiveness of business operations by focusing on quality, speed, flexibility and time to market; 3) dual focused firms aiming to exploit ICT for achieving both operational efficiency and market effectiveness; and 4) unfocused firms without any clear focus on their ICT exploitation. Managers of unfocused firms are indifferent towards ICT and they are very likely to mismanage or undermanage ICT investments, leading to vicious cycle that erodes the potential for realising payoffs from both existing and future ICT investments. Findings provided supportive evidence for the following two hypotheses: H1) managers with more focused goals for ICT perceive greater CRM benefits; and H2) managers claiming higher sophistication in their ICT management practices perceive higher CRM benefits.

FIGURE 1: PROCESS-ORIENTED MODEL FOR CRM BENEFITS EVALUATION *(Source: Sigala, 2004b)*

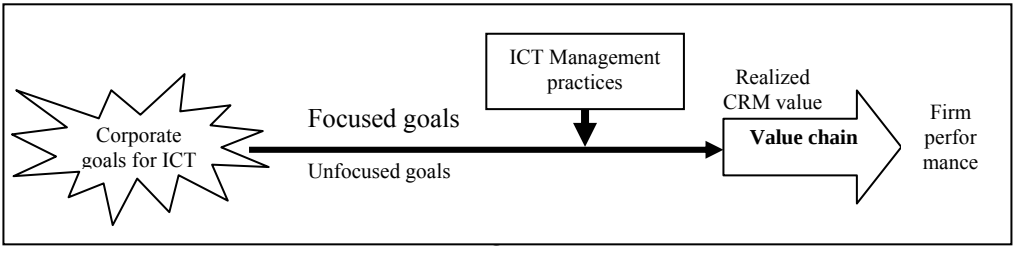


TABLE 4: PROCESS-ORIENTED CRM BENEFITS EVALUATION MODEL

Perceived degree of CRM impact on ….. Likert scale; (7) high impact-low impact (1)
Process Planning and Support
Improve internal communication and coordination
Strengthen strategic planning
Enable your company to adopt new organizational structures
Improve management decision making
Streamline business processes
Supplier Relations (Supply Chain Management)
Help reduce variance in supplier lead times
Help develop close relations with suppliers
Improve monitoring of the quality of suppliers' products / services
More efficient inventory management
Faster response to customer demand
Enable collaborative product development with suppliers
Help your company gain leverage over its suppliers
Production and Operations
Enable and support customer collaborative product development
Enable efficient production of customized tailored made products
Improve production throughput or service volumes
Enhance operating flexibility
Improve labor productivity
Product and Service Enhancement
Decrease the cost of product/service development / design
Reduce the time to market for new products / services
Enhance product / service quality
Support product / service innovation
Support project management
Sales and Marketing Support
Enable the identification of market trends
Increase the ability to anticipate customer needs
Enable and empower sales people to increase sales per customer
Improve the time and level of accuracy of sales forecasts
Help track market response to business strategies / practices
Enhance online sales

Enhance effectiveness of market targeting
Monitor and enhance effectiveness of campaign management
Customer Relationships
Enhance the ability to provide after sales service and support
Enhance the flexibility and responsiveness to customer needs
Enhance order management
Enable customer tracking and delivery management
Enhance customer contact service and channel options

Source: Sigala (2004b)

Overall, it was found that perceived CRM benefits are stronger realised when corporate goals for ICT are aligned with focused CRM applications. In other words, findings confirmed the importance of aligning ICT and business strategies for materializing CRM and ICT business value. After controlling for the impact of strategic alignment on CRM business value, results also revealed a strong impact of ICT management sophistication on perceived CRM benefits. Such findings confirm claims of previous studies regarding the effect of ICT project planning, management, control and integration with business strategies on successful CRM implementation. By highlighting the critical determinant factors of ICT management practices, findings also provide useful practical guidelines on how firms should implement successful CRM projects. Analytically, to enhance CRM benefits managers need to: 1) gain top management support by demonstrating cost reduction, revenue enhancement, or strategic impact of new CRM projects; 2) ease the implementation and use of e-CRM; 3) decide which business functions need to be automated and / or streamlined, restructured; 4) gain middle management acceptance by involving them early in the process, especially as they decide which functions to automate; 5) monitor and continually control ICT implementation.

4. A HOLISTIC FRAMEWORK FOR INTEGRATING ICT APPLICATIONS IN HOSPITALITY OPERATIONS

Based on the previous studies, four distinct areas of integration between ICT and hotel business are required for materializing the ICT productivity benefits. These are: technical, systems, strategic and organizational domains. The technical perspective is very dominant and integration is seen as a goal to make complex software and hardware artifacts communicate utilizing

appropriate protocols, conventions and technologies. This can be at the level of basic signal and data message content as well as the communication of shared semantic meaning through representation in databases and IS application systems. The technical integration is addressed and evident in previous studies by measuring the impact of ICT integration on productivity metrics. In the case of hotels, the integration of ICT systems with the Property Management System is the most important technical integration that leads to substantial benefits.

The systems domain could be described as encompassing approaches to understanding technical, strategic and organisational systems behaviour that explicitly claim to provide greater holistic perspectives or have a philosophy underpinned by general systems theory. Organisations are seen as complex and adaptive systems that have distinctive emergent properties. This is particularly true of integrated IS where complex interactions of technology, tasks and processes cannot be understood and dealt with in discrete bundles. A whole systems view must be taken. In general, four types of generic systems inter-relationships are found: stand-alone, interfaced, integrated and universal. It was argued that an interfaced system is one whose elements have one- or two-way communication with other elements but make decisions for their own benefit. An integrated system is one whose elements have two-way communication with other elements and make decisions for the collective benefit of the system. In stand alone systems there is no communication and elements take their own decisions, while in universal systems there is no individual decision making, there is centralised control and single database. The popular view was that systems integration resulted in greater coherency, co-ordination, management control and overall productivity. From these definitions comes an argument that systems integration is mostly about data, control and communications, whereby seven layers of integration can be tentatively identified as: physical, data, schedule, functions, attitudes, principles and purpose. These latter layers, attitudes, principles and purpose, necessitate closer examination of the 'softer' aspects of integration. Theories in the systems domain are plenty but are difficult to be operationalized practically. The system domain is addressed in productivity studies by identifying the process impact of ICT and its impact on business process reengineering and integration with business processes.

Integration in the strategic area has nowadays become very important. Authors propose a strategic framework for organisations that encompasses external (supplier and customer focused) and internal (intra-organisational functional areas) integration. This thinking is encapsulated in the drive to develop and adopt large scale fully integrated ERP systems which define and embody sets of 'good practice' through newly redefined business processes. The popular and widespread adoption of Business Process Re-engineering practices in the early to mid-1990s contributed to the spectacular growth of ERP systems worldwide and emphasised the problem of aligning business, organisational and ICT strategies. Strategic integration also became associated with the rapid adoption of electronic business (e-business) technologies and practices. E-business was seen as a strategy for addressing competitive issues concerned with globalisation, partnering and managing collaborative networks of suppliers and customers. The third study clearly addressed and considered impact of the ICT strategic intent and goals on the materialisation of ICT benefits.

In terms of the organisational domain within an integrated IS implementation, we need to develop a better understanding of the many issues involved. Unfortunately, each ICT implementation is unique to its context. It could be that a new or different computer system is being introduced at the level of the organisation or across sites or departments and people are being asked to change the way they work. New policies may be brought in. Managers may lose their power base. Staff may be expected to work with new departments and share or process information in new ways. There may be redundancies. Integration from an organisational perspective is a highly complex process with a number of variables. Organisational integration involves the integration of people, their ideas, and decision making processes. The organisational domain has been articulated by different researchers at different times as 'structural', 'social and historical', 'power', 'politics', 'culture' spheres of study.

In terms of structure, ICT business integration may entail: new functions, divisionalization, de-layering, downsizing, strategic business units and inter-organisational strategies. Technological change consists of mechanisation, automation, informatization, communications and imagization. They refer to cultural change which involves cultural strengthening, human resource

management, total quality management, strategic management and business process re-engineering. Hence, organisation structure, technology and cultural change must be taken into account for any integrated strategy for change.

The meaning of the social area of integration relates to the mutual relations of individuals working within organisational communities. These communities can be at the level of the team, department, unit and organisation and may be at a national or international level.

Technical systems analysis must be augmented with a social or political analysis and self examination of interests, motives, payoffs, and power bases will lend much to the implementer's ability to understand other people's reactions to the systems, the implementer is designing and installing''. In these terms, ICT integration and consideration of power and politics is important and made several researchers talk about the organisational validity of ICT applications.

Culture also plays a crucial role in the organisational validity of ICT applications and their ability to diffuse into processes and deliver organisational benefits. Some of the issues that need to be addressed are as follows:

- Innovation and action orientation: The speed with which the organisation responds to changes in the environment.
- Risk taking: The importance of risk and taking risky decisions.
- Integration and lateral interdependence: How important is co-operation and communication among organisational sub-units to achieve organisational goals.
- Top Management contact: The relationships between management and subordinates.
- Warmth or fear. Silence or constructive criticism.
- Autonomy in decision-making: where are the important decisions made?
- Performance orientation: The nature of demands placed upon organisational members.
- Reward orientation: The nature of pay and whether it is related to performance.

Sigala (2005) provides some very critical and important information on the soft organisational changes required for effective implementation of CRM systems in the hotel industry amongst which are: reward systems, knowledge circles, culture, social skills and interpersonal competences, top management commitment, management style, culture, promotion systems etc. However, there is a need for more in-depth research into the soft organisational issues that are required and are important for enabling the materialisation of ICT benefits. Table 5 summarises the previous discussion into a holistic framework

TABLE 5: INTEGRATING ICT INTO BUSINESS PROCESS

Domains of integration	Analytical methods & tools	Communities of practice	
Technical: data, communication, automation	Data/Systems, Design Analysis Methods/Tools	ICT user communities	**Technical domain**
Systems: workflow, operations, business processes		ICT professional communities	
Strategic: internal, external	Strategic analysis	Industry leaders, consultants, executives	**Strategic domain**
Organisational: social, political, working	Structural analysis Social and historical context Power and political analysis Cultural analysis	Organisational actors	**Organisational domain**

5. CONCLUSIONS AND RECOMMENDATIONS

Despite the increasing ICT investments, the productivity impact of ICT has been elusive. The study contributed to the body of knowledge by critically reviewing previous studies investigating the ICT productivity paradox and

developing a framework for enabling the materialisation of ICT benefits. Analytically, four areas of integration are required for effectively diffusing and aligning ICT applications into business processes namely technical, system, political power, organisational.

REFERENCES

Avkiran, N.K. (1999). *Productivity Analysis in the Services Sector with Data Envelopment Analysis,* Camira, Queensland.

Ball, S. (1993). *Productivity and productivity management within fast-food chains – a case study of Wimpy International*, MPhil thesis, University of Huddersfield, UK.

Banker, R. D. and Morey, R. C. (1986). Efficiency analysis for exogenously fixed inputs and outputs, *Operations Research*, Vol. 34, 513-521.

Bender, D. (1986). Financial impact of information processing, *Journal of Management Information Systems*, Vol. 3, 232-238.

Bresnahan, T., Brynjolfsson, E. and Hitt, L. (2002). Information Technology, workplace organisation, and the demand for skilled labor: firm-level evidence. *The Quarterly Journal of Economics,* February, 339-376.

Brynjolfsson, E. and Hitt, L. (2000). Beyond computerisation: Information Technology, Organisation Transformation and Business Performance, *Journal of Economic Perspectives*, XIV, 23-48.

Brynjolfsson, E. (1993). The Productivity Paradox of Information Technology, *Communications of the ACM*, Vol. 36, 67-77.

Byrd, T. and Marshall, T. (1997). Relating IT investment to organizational performance: A causal model analysis, *International Journal of Management Science*, Vol. 25, 43-56.

Cron, W. and Sobol, M. (1983). The relationship between computerisation and performance, *Information Management*, Vol. 6, 171-181.

Dasgupta, S., Sakris, J. and Talluri, S. (1999). Influence of information technology investment on firm productivity: a cross-sectional study, *Logistics Information Management*, Vol. 12, 120-129.

Dos Santos, B.L., Peffers, G.K. and Mauer, D.C. (1993). The impact of Information Technology investment announcements on the market value of the firm, *Information Systems Research*, Vol. 4, 1-23.

Gummesson, E., (1998). Productivity, quality, relationship marketing in service organizations, *International Journal of Contemporary Hospitality Management*, Vol. 10, 4-15.

Hitt, L. and Brynjolfsson, E., (1996). Productivity, Profit and consumer welfare: three different measures of information technology value, *Management Information Systems Quarterly*, Vol. 20, 121-142.

Johns, N., Howcroft, B. and Drake, L., (1997). The use of Data Envelopment Analysis to monitor hotel productivity, *Progress in Tourism and Hospitality Research*, Vol. 3, 119-127.

Jones, P. (1988). Quality, capacity and productivity in service industries, *International Journal of Hospitality Managemen*t, Vol. 7, 104-112.

Jurison, J. (1996). Towards more effective management of information technology benefits, *Journal of Strategic Information Systems*, Vol. 5, 263-274.

Lucas, H.C. (1993). The business value of Information Technology: a historical perspective and thoughts for future research, In Banker, R., Kauffman, M. and Mahmood, M. (Ed.), (pp. 127-139) *Strategic Information Technology Management*, Idea Publishing, Harrisburg, PA.

Menon, N.M. (2000). *The impact of information technology: evidence from the healthcare industry*, Garland Publishing, New York.

Norman, M. and Stoker, B. (1991). *DEA the assessment of performance*, Wiley, London.

Paradi, J., Reese, D. and Rosen, D. (1997). Applications of DEA to measure the efficiency of software production at two large Canadian banks, *Annals of Operations Research*, Vol. 73, 91-115.

Sengupta, J.K. (1988). A robust approach to the measurement of Farrell efficiency, *Applied Economics*, Vol. 20, 273-283.

Shafer, S. and Byrd, (2000). A framework for measuring the efficiency of organizational investments in information technology using data envelopment analysis, Omega, *The International Journal of Management Science*, Vol. 28, 125-141.

Sigala, M. (in press, 2005). Integrating Customer Relationship Management in Hotel Operations: managerial and operational implications, *International Journal of Hospitality Management.*

Sigala, M. (2003). The Information & Communication Technologies productivity impact on the UK hotel sector, *International Journal of Operations and Production Management*, Vol. 23, 1224-1245.

Sigala, M. (2004a, in press). Integrating and exploiting Information and Communication Technologies (ICT) in restaurant operations: implications for restaurant productivity, *Journal of Foodservice Business Research.*

Sigala, M. (2004b). *Customer Relationship Management: diffusing CRM benefits into business processes*, European Conference in Information Systems (ECIS) 2004 Conference, Best Paper Award, Turku, Finland, 16-18 June, 2004.

Sigala, M., Airey, D., Jones, P. and Lockwood, A. (2001a). *Investigating the effect of multimedia technologies on employment patterns in UK tourism and hospitality industry*, In Sheldon, P., Wober, K. and Fesenmaier, D. (Ed.) (pp. 205-215). ICT in Tourism 2001, Springer Verlag, Vienna.

Sigala, M., Lockwood, A. and Jones, P. (2001b). Strategic implementation and IT: Gaining competitive advantage from the hotel reservation process, *International Journal of Contemporary Hospitality Management*, Vol. 17, 364-371.

Sigala, M., Airey, D., Jones, P. and Lockwood, A. (2000). *The adoption and diffusion of multimedia technologies in the tourism and hospitality sectors*, In Fesenmaier, D., Klein, S. and Buhalis, D. (Ed.), (pp. 397-407) ICT in Tourism 2000, Springer Verlag, Vienna.

Siguaw, J.A., Enz, C.A. and Namasivayam, K. (2000). Adoption of Information Tehcnology in U.S. hotels: strategically driven objectives, *Journal of Travel Research,* Vol. 39, 192-201.

Strassmann, P. (1990*). The Business Value of Computers: an Executive's Guide*, The Information Economic Press, New Canaan, Connecticut.

Venkatraman, N. and Zaheer, A. (1990). Electronic integration and strategic advantage: a quasi-experimental study in the insurance industry, *Information Systems Research*, Vol. 3, 307-333.

Weill, P. (1992). The relationship between investment in IT and firm performance: a study of the valve manufacturing sector, *Information Systems Research*, Vol. 3, 307-333.

The Cyprus Journal of Sciences, Vol. 3, 2005/191-224

ON-LICENSED RETAIL TRAINING PHILOSOPHIES AMONGST TENANTS, LESSEES AND FREE-HOUSE OPERATORS

CAROLINE ANN WISCOMBE*

ABSTRACT

This study investigates the training philosophies of independent businesses in the licensed retail sector of the hospitality industry within the UK. This is achieved by studying attitudes of tenants, leaseholder and freehouse operators (TLFO) toward training and their approach to the development of their staff. The study is necessitated by the knowledge that where extensive customer service is necessary for competitive advantage and business growth this can only be fulfilled through improving skills and attributes of owners and staff using competent human resource management (HRM) practices.

Key words: licensed retail, training philosophies, customer service, human resource management

1. INTRODUCTION

The hospitality industry is one of the major industries within the United Kingdom (UK). It has provided year on year growth in terms of Gross Domestic Product (GDP) since 1996, contributing some £21.5 billion annually to the Treasury through direct and indirect taxation and provides one in five of all new jobs (HtF, 2001, i). The on-licensed retail sector is a major part of this industry supporting tourism through its uniquely British culture and place in history. Over the 2,000 years since the first Roman Tabernae, the on-licensed retail sector has developed into a multi-billion pound business providing one of the most dynamic and evolutionary contributors to the Hospitality Industry.

* University of Wolverhampton, Department of Leisure, Tourism and Hospitality, School of Sport, Performing Arts and Leisure, Walsall Campus, United Kingdom

The on-licensed retail sector represents 26% of the country's hospitality and catering businesses (HtF, 2001 i), contributing significantly to the economy of the U.K. through earnings generated from both domestic and international markets. The on-licensed retail sector employs 16% of the total 1.76 million people working in the hospitality industry (HtF, 2001 i), and this is set to increase from 272,000 employees in 1999 to 351,000 by 2009, higher growth than any other sector in the industry (HtF, 2000).

The licensed retail sector is diverse and dynamic in culture with its organisational structure changing dramatically in the last ten years. Since the early 1990's the dominance of the multiple outlet pub retail companies has grown significantly, (see figure 1) where previously 80% were owned by the brewers with six major companies dominating the market in 1972 (Preece et al, 1999).

FIGURE 1: THE LICENSED RETAIL INDUSTRY: CHANGES IN OWNERSHIP SINCE THE BEER ORDERS (*Pub Industry Handbook, 2003 p.7)*

Type of	**Date**					**% change**
operator	**11/92**	**04/96**	**01/00**	**01/02**	**01/03**	**92-'03**
National Breweries						
Tenanted/Leased	9,700	10,467	2,724	1,110	1,121	-89%
Managed	9,500	8,534	7,336	1,400	1,400	-85%
Sub Total	19,200	19,001	10,060	2,510	2,521	-87%
Regional Breweries						
Tenanted/leased	10,000	7,986	5,939	5,495	5,842	-42%
Managed	5,000	2,968	3,498	3,176	2,807	-44%
Sub Total	15,000	10,954	9,437	8,671	8,649	-42%
Independents						
Single Outlets	15,800	16,062	18,098	17,130	17,050	8%
Multiple Outlets	8,000	11,288	24,196	33,180	32,654	308%
Sub Total	23,800	27,350	42,294	50,310	49,703	109%
Total	58,000	57,305	61,791	61,491	60,873	5%

Small and medium size enterprises (SMEs), (see figure 2,) characterise the hospitality industry, most employing 10 people or fewer. In the on-licensed retail sector this number falls to an average of 6.5 people per establishment

(Annual Employment Survey, 1998 in HtF, 2001 i). Small hospitality businesses account for 90% of establishments with only 3.6% employing more than 25 people each, but together those 3.6% employ the largest proportion of the hospitality workforce in Great Britain.

FIGURE 2: DEFINITIONS OF SMALL AND MEDIUM SIZE ENTERPRISES

There is no universally accepted definition of an SME (Small to Medium size enterprise.)

Definitions used can vary widely among countries but are usually based on employment. In general an SME is considered to have fewer than 500 employees, although many countries use a lower cut off of 300 or even 100 employees.

Whilst the European Union (EU) defines SMEs as having fewer than 250 employees, the Organisation for Economic co-operation and Development (OCED) makes the following distinctions:

- Micro companies (1-4 employees): 88% of on-licensed sector are classed as small and micro businesses
- Very Small companies (5-19 employees): Average number of employees in outlets is 6.5 in 1998
- Small companies (20-99 employees): usually managed houses
- Medium size companies (100-500 employees): brewery companies

Source: Adapted from Lange et al, (2000), HtF, (2001 i)

Mintel (2002, i) reports that the number of pubs has stabilised after a decade of decline and that the overall sector is performing well with leading pub operators (see figure 3) continuing to boost pub revenues. Pub catering has been the strongest source of growth, needing new skills and attributes amongst those working in the industry, and this growth has helped mask the decline of beer and other alcohol sales (Mintel, 2002, ii).

There are now 60,000 pubs in the United Kingdom (UK) with 900,000 people relying on beer and pubs for their employment. The average pub injects £73,000 per annum into its local economy with excise duty and VAT raised on UK beer sales amounting to £5.3 billion per annum (McNammarra, 2003). This, along with UK beer exports doubling since 1992 (McNammarra, 2003), makes the licensed retail sector an important one to consider in political, economic, social, technological and organisational terms.

FIGURE 3: THE TOP TEN MULTIPLE PUB OPERATORS IN THE UK BY SIZE OF ESTATE

		No of	No of	
		Managed	Tenant/	Total
Ranking	Pub operator	Houses	Lease	Outlets
1	Enterprise Inns PLC		5,277	5,277
2	Punch Pub Company		4,484	4,484
3	Unique Pub Company		4,082	4,082
4	Pubmaster	300	3,228	3,528
5	Scottish and Newcastle	1,400	1,121	2,521
6	Six Continents Retail	2,042		2,042
7	Greene King PLC	631	1,055	1,686
8	Wolverhampton and Dudley Breweries	486	1,142	1,628
9	Spirit Group	1,039		1,039
10	InnSpired Pubs PLC		1,022	1,022
11	Wellington Pub Co		833	833
12	Avebury Taverns Ltd		800	800
13	J.D. Wetherspoons PLC	650		650
14	Laurel Pub Co	612		612
15	The Pub Estate Co. Ltd	5	504	509

Source: Adapted from the Pub Industry Handbook 2003 p. 29, 46, 51 & 55

All is not sunshine however. Morrison et al (1999, p.133) defines entry into the Tenant, Leasehold and Freehold on-licensed sector as an entrepreneurial activity. Entrepreneurial organisations per se dislike paying attention to financial controls and "number crunching". This combined with low barriers of entry mean that many licensed retailers are unaware of the "managerial and operational requirements of a business" (Morrison et al, 1999, p.136). This is a serious problem for the sector as pub businesses have reached the accolade of 'second most likely to go bankrupt' (Stoy Hayward, 1996).

Socially and economically the on-licensed retail sector is vital in the United Kingdom with 80% of adults using pubs frequently (Publican Newspaper

2001). Furthermore, pubs top the list of most visited tourist attractions with 85% of tourists preferring our pubs to their bars at home, (Mintel 2002 ii). Pubs serve 1.3 billion meals per year and 16 million people drink in a pub at least once a week (Publican Newspaper, 2001). The high street bar sectors grew by 22% in 2001 and is now valued at almost £2.5 billion. Sales forecasts for 2002 predicted that sales would reach £2.75 billion (Mintel, 2002 i).

"Increasingly fierce competition in today's marketplace coupled with heightened expectations of customers, have caused companies to continue looking for ways to improve their operations" (Bommer et al, 2002). Clarke et al (2000) maintain that the way forward for the sector includes the demand for pub like service concepts selling alcoholic drinks with 'bohemia type' restaurant facilities and aspects of continental café bars. This they conclude would lead to a better quality of service.

Some operations have already picked up the challenge with the 'service ethos' beginning to develop and change the perceived culture of the sector. 'O' Neills,' 'Regent Inns' and 'Walkabout' as well as 'Wizard Inns' are moving so that staff do not just serve drinks and food but take on the character that fits into the theme. Four years ago Wizard Inns also began providing table service at some of their outlets and by the end of 2002 they were providing table service at most of their 65 managed houses. With table service staff on the floor now generating 20% of sales they have shown increasing demand from customers for this improvement in service, (Hutt, 2002).

This differentiates the product that Porter (1980) in Mintzberg, Ahlstand and Lampel (1998, p102) determines as one of the two methods of competitive advantage a firm can create. However Jerome and Kleiner (1995) show that investment in the people of the industry are fundamental to its future ability to provide extended customer service and thus remain confident of continuing competitive advantage.

Heskett et al (1994) take this further and show that businesses in the service-profit chain have established relationships between profitability, customer loyalty and employee satisfaction and the need to work toward a particular paradigm in which frontline workers and customers become the driving forces behind business growth. To harness this effectively requires four

major factors to achieve success: investment in people, technology that supports front line workers, revamped recruitment and training practices and compensation linked to performance for employees at every level. Human Resource Management therefore becomes a crucial element in business growth within the On-Licensed Retail Sector with training needing to be a core philosophy.

Lack of uptake of qualifications within the sector is highlighted through a number of studies (Pratten, 2001, Lashley and Rowson, 2000). This study explores the facts behind those findings as, if they indicate a lack of human resource development, they would ultimately damage the competitive power of the sector against the wider competition from other leisure pursuits.

This study therefore aims to show whether lack of qualification shows a lack of training and if so what factors are preventing such self-development taking place. The study also seeks to see if this is limited to the owner/operators of the businesses or whether this reaches into the development of staff.

1.1. Research objectives

- To identify the levels of qualification of licensee in TFLO.
- To establish the perception of licensees towards training and qualifications.
- To examine the processes used for training staff by TLFO.
- To evaluate the On-licensed retail sector against the existing literature on training in SMEs.

2. THE IMPORTANCE OF TRAINING

The on-licensed retail industry has changed from a service that was originally targeted at the male blue-collar worker to one that now caters for an extensive range of clientele. Keynote (2002) describes how pubs have had to reinvent themselves to confront the challenge of take home beer, in home entertainment, health conscious eating and drinking, and the crackdown on drink-driving. The on-licensed retail sector is being driven by the creation of competitive advantage through the product offering, whether that is through

increased customer service, as in the case of Wizard Inns, or through increased diversity of the retail offering, such as changes in menus. This supports Edgar and Nesbit's view (1996, p.6.) that "Today's (hospitality) businesses are operating in complex and turbulent environments with pressure to adapt and change to survive".

In this scenario of constant change and evolution, training becomes a key issue in all areas of the business whether in customer service, (Jerome & Kleiner, 1995), skills gaps and deficiencies, (Thomas et al, 2000), or driving for increased profits, (Bagshaw and Bagshaw, 2002). The training definition is important as it can help to demonstrate the culture of the company, whether it has a laissez fair approach, pays lip service to training or whether it has a positive training philosophy (Armstrong, 2001).

> *"Training is the formal and systematic modification of behaviour through learning, which occurs as a result of education, instruction, development and planned experience…..and the fundamental aim of training is to help the organisation achieve its purpose by adding valued to its key resource – the people it employs.*
>
> *Training means investing in people to enable them to perform better and to empower them to make the best use of their natural abilities"*
>
> (Armstrong, 2001, p. 542-543).

Human resource management is crucial to success and it is acknowledged that "Organisations with a positive training philosophy understand that they live in a world where competitive advantage is achieved by having higher quality people that other firms employ" (Armstrong, 2001, p 545). It is also true that "any company wishing to survive in an increasingly competitive world must utilise effectively and efficiently its most valuable asset – the skills of its employees….training can be a powerful building block for a foundation of understanding and skills that will help an organisation reach its business goals" (Lin and Darling, 1997, p. 193).

If the aim of the training is to improve business growth and customer service, in accordance with Heskett's paradigm (Heskett et al, 1994), then businesses need to make sure they are using appropriate methods. Read and

Kleiner (1996) show that the correct method of training, which takes into account learning theory, is directly linked to results.

Billson (1998) argues that external training courses (formal or qualification driven courses) have less impact on business results than do 'just in time' or 'one to one coaching sessions'. This may be because one-to-one coaching sessions have an immediate reinforcement phase (Mayo & Dubois 1987).

Simms (1990) conversely shows that whilst no single training method is superior the results to be achieved have a determining factor in the choice made. However there are many different ways of training and new methods and variations are constantly being added.

In developing the correct methods of training for a customer service driven organisation the companies have to go beyond the technological aspects of service. To do this needs different training techniques. This includes coaching and mentoring from supervisors and even working alongside colleagues and absorbing their techniques and experiences (Armstrong, 2001, McCrae, 1996). Drejer (2000) describes this as a tacit understanding of the development of competence.

"Planning for training and development ….. is not always a deliberate measure; rather often it occurs only as a result of problems" (Mühlemeyer & Clarke, 1997, p.5). However, to utilise training effectively a company needs to define "the gap between what is happening and what should happen" (Armstrong, 2001, p551) and then plan to change that which is going wrong. "This is what has to be filled by training. The difference between what people know and can do and what they should know and be able to do." (Armstrong, 2001, p551).

FIGURE 4: EFFECTIVE TRAINING METHODS IN DELIVERING BUSINESS RESULTS

Approach	**Key Features**	**Likely impact on delivering business results**	**Implications for On-Licensed Retail**
1. External Training Courses	• generic subjects • not tailored	Low	Leaving the business and travelling to a college or training room
2. Internal courses/workshops	• some tailoring • large groups	Low +	External trainers coming to the pub
3. Self Learning via multi-media packages	• tailored • practices/thinking based	medium	Use of computer or TV screen to run DVD, CD or video packages
4. Small group coaching	• highly tailored • case study based • groups of 4-8 short frequent sessions	High	Supervisors or owner offering in house coaching specific for the pub premises. E.g. fire safety
5. Action learning	• highly tailored • focused on live business situations • short frequent sessions	High	Recap sessions on what has happened and why in any given shift or a function
6. One to one coaching	• focused on live business situations • time consuming but rewarding for both parties	Very High	Supervisor or owner/operator focusing on one aspect of service with only one member of staff.
7. Just in time training	• highly tailored to immediate needs • small groups or individuals • use of action learning or coaching • short frequent sessions	Very High	Immediate at the time training often used before a special event or function. Can be used with new member of staff in pouring a new product. Often used in opening wine in situ.

Source: Adapted from Billson, I. (1998). How just in time training can support business led competency development, Competency, Spring, pp21-24 by Armstrong. Options in delivery pg. 561

The indication is that companies should be using some sort of plan for training to enable this to happen with evaluation as a fundamental part, particularly that business benefits are matched against the cost of training (Bramley and Kitson, 1994).

According to Mühlemeyer & Clarke (1997, p. 5) the more common approach is to pay lip service to training. In being prepared to provide resources for management training, they take the approach of "ordering from a travel brochure". Preparation involves a map, directions on how to get to the venue and car parking and distinguishing whether lunch will be provided. Evaluation of training may involve asking "if the trainer was good, the participants friendly and the accommodation and/or food OK". Evaluation of learning and progression into adopting what was learnt into the workplace is far removed from such discussion.

If attitudes are as Mühlemeyer & Clarke (1997) define then every investment in training, whatever the cost, is a waste of money. Trainees will feel frustrated, lacking the success that application of learning could bring, and employers will be unable to evaluate its true benefits.

The questions asked in this study seek to find out if there is training, whether in order to provide customer service, skill gaps and deficiencies (particularly in legislative areas), or is in place to drive increased profits, that involves a training plan. This would determine whether a training philosophy exists that pays more than lip service to the development of people. The link between training and business objectives is examined in order to make this assumption however the study also seeks to evaluate the discussions of Pratten (2001) who puts forward the argument in his work that qualification is a suitable measurement of whether training is being used.

This work already challenges that argument using the hypothesis that the on-licensed sector may be using the correct method of training for the results needed. The method may not use qualification but the use of planning and evaluation techniques would show if training were being utilised effectively – more important perhaps than a certificated course. The knowledge of how many businesses have training plans and philosophies, incorporating other types of training or methods of development, rather than measuring the number

of qualifications will therefore be a useful tool in measuring the training philosophies of TLFO.

3. SMALL AND MEDIUM SIZE ENTERPRISES

The Hospitality Training Foundation (HtF, 1999) survey of training in the UK confirmed that, although there had been improvements since its earlier study, (HtF, 1996) much training in the hospitality industry was still largely aimed at simple induction and reaching statutory requirements. Hospitality employers per se do not seem to take on board the importance of training and whilst many firms were supplying some development this did not apply to all employees. Management, supervisors and craft employees are more likely to be trained by their employers than by outside agencies.

The National Survey of Tourism and Hospitality Firms (Thomas et al, 2000) found that whilst a quarter of all firms cite skills gaps or deficiencies in their employees only 8% of public houses and bars indicate they had a training budget. This differs to those operating visitor attractions where 29% is the norm. The study also found that 48% of respondents were unsure of local provision and programmes for staff development.

Further studies of the hospitality industry continue to reflect a national picture that does not value skills and qualifications (HtF, 2000). The industry "often has a poor reputation as an employer that engages to different extents, and in a variety of different ways, with training provision" (Dewhurst et al, 2002, p. 34).

The Publican Conference 2002 demonstrated many examples of good practise in developing appropriate human resource strategies and training packages amongst large companies in the on-licensed retail sector. These included 'Punch Retail' and 'Wetherspoons'. However gaps were also highlighted between the development of staff in large companies and those working for small independent businesses. The inference in making the judgement seemed to be lack of formal human resource measurements, such as Investors in people standards (IiP), and/or lack of uptake of formal qualifications. This supported other views; Pratten and Soffield (2002) and

CAMRA (1998) also infer that tenants, leaseholders and freehouse owners have been left behind in undertaking and providing training.

A key characteristic however of the hospitality industry is its large number of small and micro businesses. Many hospitality businesses are defined as Small to Medium Size enterprises (SME's) (see figure 3). Businesses with between 1 and 10 employees made up 90% of establishments in the industry in 1998 down from 91% in 1997, although they employed only 33% of the workforce. The proportion of large establishments (employing more than 25 people) has increased from 3.2% in 1997 to 3.6% in 1998. 88% of the licensed retail sector are classed as small and micro businesses with the average number of employees in outlets standing at 6.5 in 1998 (HtF, 2001 i).

SMEs and particularly micro businesses traditionally view training as something that happens when necessary and not as part and parcel of a continuous skills development process (Lange et al, 2000). However, as well as this it is acknowledged that many licensees will be in a lifestyle business where the interest in training and development is not a priority. These proprietors may also see business levels as adequate, and even comfortable, (Lashley, 2001).

Such complacency in difficult competitive environments is questionable especially when combined with the challenges caused by changes to micro and macro environments. These changes can have devastating effects on income, profitability and even the ability to continue in business; examples include the Foot and Mouth epidemic on rural pubs, 11/09 on urban pubs and the new legislative changes with its causal effect on organisations, staffing levels and customer expectations.

A range of reasons can be identified for the lack of engagement in training amongst SMEs, including organisation size and sector, (Chatrik, 2001, Dewhurst et al, 2002), perceived barriers to training, particularly the inherent culture of the industry (Ashton and Felstead, 1995, Eaglen, Lashley and Thomas, 1999), costs of time and money, (Huang 2001, Lange et al, 2000), labour turnover issues, (Lashley and Rowson, 2000) and a lack of awareness of training provision (Dewhurst et al, 2002). Whilst the demand for suitably skilled employees does not diminish, the lack of training is of grave concern in

relation to the continuing demand for improved services within the sector (HtF, 2001, ii).

SMEs undoubtedly suffer considerable difficulty in accessing formal training. Large companies with HRM (Human Resource Management) departments have access to both resources and knowledge to drive forward initiatives. Chatrik, 2001, puts lack of knowledge of both qualifications and the assistance available as a major influence on training uptake within SMEs. This is supported by the findings of SME training analysis in the Shropshire area where Dewhurst et al, (2002) promote increased accessibility to information as a crucial aspect of developing SME training. Professional bodies and government agencies argue that information is freely available through a number of communication channels but the problem for SMEs is that if they are not on appropriate mailing lists they may well miss out (Wiscombe, 2002).

Financial factors involved in training include direct costs of the product (the course or programme), personnel costs of wages or salary paid to the employee, cover for that employee in the workplace and the indirect costs of disruption to service or production systems (Campbell, 1994). Whilst managers continue to avoid the use of economic justification for training, and directly link these to improvements in the business performance, costs will continually be a barrier to SME uptake of training.

Whilst Huang (2001) found that SMEs high direct costs of training were the main barriers to training, time pressures were also a factor. Forsyth (1999, 2000) shows that many SMEs, especially those in the micro business category, are too small to have enough staff to cover in case of absence. Staff in SMEs is already at a stretched capacity and to be available for formal training would be almost impossible to accommodate (Lange et al, 2000).

Lange et al, 2000, have argued that it is a particular problem of micro businesses that their owners view training as something that happens when necessary and not as part and parcel of a continuous skills development process. However it must be acknowledged that there is a long history of managerial amateurism across the hospitality industry (Ashton and Felstead, 1995) and many hospitality managers are inadequately trained. They are not naturally convinced of the value of an investment in training activities,

(Eaglen, Lashely and Thomas, 1999) therefore it may be that it is not the cost, time, accessibility, or knowledge that is lacking but a fundamental difficulty in understanding what training can offer the business.

For SMEs owners and managers play a pivotal role in making the decisions regarding formal, job related training (Matlay, 1996). This differs greatly to large companies where one person's view of training would not undermine a company's drive toward the training philosophy being adopted (Armstrong, 2001). The attitude of owners and managers is therefore crucial to the drive toward development in the sector (Stokes, 2001) and this argument is supported when studying the enthusiasm toward training within winners of the "Innkeeper of the Year" competition (Palmer, 2003 ii). Therefore if the attitude of the owner/licensee is wrong, training will not be encouraged or provided.

To support the fostering of positive attitudes to training, learning and development in the work environment the internal marketing of training courses is crucial. Making sure courses are relevant and clearly communicating their advantages will maximise the motivation and benefits (Axtell et al, 1997).

To encourage training uptake it is also important that trainees successfully transfer learned skills in the period immediately following their return to work. This means that employers must have detailed knowledge of what it is they have learned and when it is being learned. To achieve this, closer links are needed between trainer, employer, and employee (Ford et al, 1992). This is particularly important where employees are out on college day release programmes where their immediate work role may not allow them to practice their learning (Wiscombe, 2002). Employers may also expect that new skills and knowledge would automatically be applied in the workplace but, if management do not give relevant opportunity, transfer of these benefits may not take place (Ford et al, 1992). Employers must provide the environment in which new skills may be consolidated, enabling reinforcement of the training to take place, and opportunities created for further development.

Monk (1996) puts forward an argument that Knowles (1978) got it wrong when he quoted Lindeman (1926) as saying that the great majority of adults are not interested in learning and are not motivated in the direction of continuing education. Knowles (1996) assumed that if they were interested they would

take advantage of the numerous free offers that are available but evidence shows that free training or subsidised training is not necessarily the answer to uptake amongst adults (BII, 2000). This may be because adults are put off by the "rigid, uncompromising requirements of authoritative, conventionalised institutions of learning" (Monk, 1996, p.27). This begs the question then that it may be the fault of colleges and training institutions in not providing the right atmosphere of learning and being too formal in their accessibility that deters the adult learner.

Wiscombe, (2003), explains using the example of a member of staff, terrified of examinations who would not attempt the NCL, for many a simple multi-choice examination but one in which attendance at college would be necessary. She therefore was persuaded to take, successfully, the telephone "test" for the PBQ, a self-study, coaching, in house method of delivery. This allowed the learner to set her own level of learning and gain confidence from her success. Enterprise PLC use similar tactics: when starting the training day the trainer allows the trainee to set their own objectives – they do not impose a set of rigid rules. This allows the motivation of the learner whilst working to their own capability (Grieve, 2003).

Monk (1996, p.27) points to a trainers "style, commitment and enthusiasm" as a major motivator in helping learners achieve. As "each profession has its own mix of factual knowledge, theoretical understanding, process knowledge, tacit knowledge and communicative competence" (Barnett, in Boud and Garrick (1999), p. 30) communication can also be seen as a key factor. "The pedagogic baggage that both tutors and associates carry is clearly a barrier that needs working on, as is developing different interpersonal tools of communicant and style" (Bray, 2002, p. 23). In other words trainers need to be able to talk in language and metaphor that their trainees and employers can understand in order to extend the uptake of training.

4. METHODOLOGY

The study used a multi-method approach to this "real world research" in order to ensure that exploratory, descriptive and explanatory work was carried out and to establish the best method for the results required (Robson, 1993 &

Gill and Johnson, 2002). Exploratory work was done through the literature review and pilot studies, both of which helped to inform the questionnaire.

4.1. Pilot studies

Loftland and Loftland (1984) and Stebbins (1987) remark that to complete a successful study there is a need to have enough knowledge about the setting or persons you wish to study to appear competent to do so. In order to define the methodology pilot studies of five independent licensed retail operators were undertaken in April and May 2003. Care was taken to protect the anonymity of these pilot studies which are labelled LR001 through to LR006 where used within the text. The pilot study interviews were done using semi-structured questioning techniques that gave the opportunity to probe answers and explore the complex social phenomena that is the on-licensed retail sector (Miles and Huberman, 1994). The pilot study work has enabled a process of the data gathering to be developed and practised as recommended by Robson (1993, p.301).

The pilot studies allowed access to independent perceptions on training in the industry, which then informed the research instrument to achieve the research objectives. They also established a picture of the industry by sampling a variety of businesses and companies within the industry that ensured extrapolating inferences were not made (Loftland and Loftland, 1984).

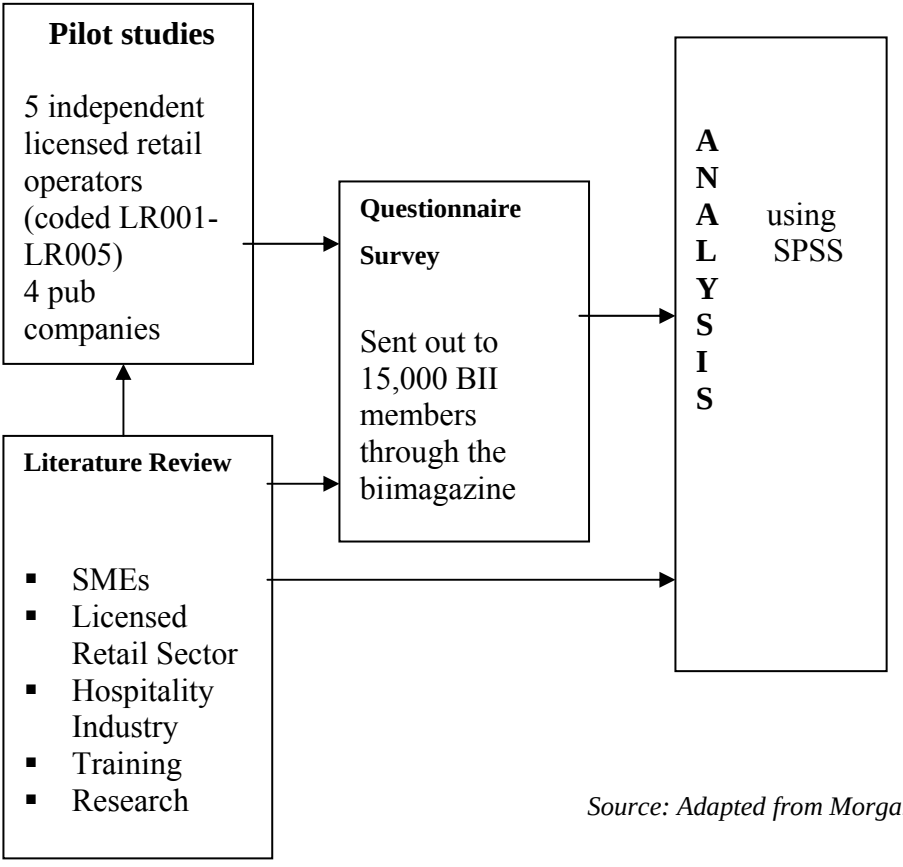
4.2. Pub companies

It was felt important to have a full view of training and its problems within the on-licensed retail sector before writing the questionnaire and so three large pub operating companies and one managed house estate were approached to discuss both good and bad practises within the industry. Semi-structured questions were used but were very fluid to allow the companies to express their views in as wide a context as possible. All participants were equally happy to criticise, as well as praise the exemplary, which helped to form an accurate representation of the barriers the companies and their licensees faced.

4.3. Questionnaire

In order to obtain the data needed for this study a sample could have been taken, spread geographically and by size of establishment. However the opportunity was offered to use the BII database and mail-shot out to all members not all of whom are licensees.

FIGURE 5: THE MULTI METHOD RESEARCH STRATEGY



Source: Adapted from Morgan (1983).

Buchanan et al (1988) approves this multi-method of survey and in itself it allows an accurate framework for the quantitative study to be developed. The analysis of the questionnaire using SPSS was then used to link the different

variables, which may be factors in the uptake of training, together to help provide a whole picture of the industry. Closed, quantitative questions were used in the most part although there was some scope for qualitative comment through some open questions.

Size of turnover, size of staff and gross profits were used to determine the focus and make up of the sample which allowed a cross sectional study to be undertaken and ensured fair representation of the industry (Robson, 1993) however Lincoln (2003) feels this survey to be biased within the context of only administering the questionnaire to BII members. In defence it can be argued that if it is found that the training culture of the professional body membership, who sign up to the mission statement, is flawed then it can be extrapolated that the culture of those outside such a professional body would be even worse. We can then have a "degree of confidence as to the state of affairs of the population" (Robson, 1993, p. 49). There is a need to keep in mind that the findings will be specific to the group studied (through selection method) and that there are some construct effects (LeCompte and Goetz, 1982). One of these effects could be that only those interested in the wider context of training may have filled in the questionnaire.

15,000 questionnaires were issued as a loose-leaf addition of the membership magazine and guidance was sought through the BII on expected return rates for the questionnaire. The first constraint on useable returns would be that of the 15,000 members the institute estimates that 25% are freehouse owners, 39% are tenant and lessees, 28% are managed and 8% are 'other' types of member (Harman, 2003). This then gives an overall picture of 13,900 possible useable responses. In similar survey methods where a prize is offered on completion of the questionnaire or other offer, a 5% completion rate could be expected. Without the ability to offer a prize or reward for filling in the questionnaire it was expected to receive between a 1% and 3% return rate.

210 responses were received by the due date however during the following fortnight a further 41 were received giving a total of 251 responses. These were included in the study giving a return rate of approx. 1.8 %. Of these, 36 were filled in by managers and removed from this study. (Further work will be done in the future in comparing managed and TLFO attitudes to training through these questionnaire responses). Some questionnaires had missing data

(turnover and gross profit questions in particular) but the diversity of other responses showed this did not affect the results. SPSS was used to analyse the data with the first thirty questionnaires were inputted by the researcher and tested against the predetermined cross tabulations for accuracy of variable entry. A team of research assistants were then used to help input quantitative data from the questionnaires, taking care to input the data in order of receipt, in order to understand any inferences on reliability from late and non returnees (Neville, 2003, Oppenheim, 1966). It was noted after the initial entry that the first question had not been fully completed by some participants and in hindsight it is noted that this would have been more appropriate as two questions.

Evaluation of the questionnaire shows it would have been useful, given the lesser number of returns, to enclose an opportunity to put telephone numbers so that follow up calls could have been made, particularly on attitudinal questions or where open questions had given new areas of thought. There would also have been a use in including a postcode question so that differences in geographical area could have been noted. There was also an error in the first question which testing did not highlight. This is only to be expected in a new research area (Becker, 1965). Overall though, the methodology has served the research well providing very useful qualitative as well as quantitative data.

4.4. Overview of responders

From the 215 responses it was determined that a comparable number of tenancies, freehouses and lessees were represented as that mirrored in the sector as a whole. Type and style of businesses were wide ranging and various with a large number of sizes of business from under £100,000 to over £1 million in turnover. The business responses showed more licensed retail businesses in the mid-range categories than in higher brackets of turnover. Locations were varied although less town pubs than rural ones responded to the survey. However more town pubs are managed than there rural counterparts and therefore this was an expected result. 65% of businesses were micro companies with a further 30% in the very small category. Only 13% of responders signified that they had seasonal differences in full time staff numbers and 26% that they had seasonal differences in part time employment capacity.

5. FINDINGS

Hankinson and Bartlett (1997) show SME owners' capabilities driven more by experience than qualification but the licensed retail sector shows a high degree of education in a variety of industries. The questionnaire results show that 76.7% have been educated to GCSE or O'Level standards of education with 76 or 46% of these going on to take A-Levels. Over a quarter (25.6%) of respondents had qualifications of an undergraduate degree or above with 4.2% having a Masters Degree or PhD.

Whilst a 100% of respondents held the BII NLC, or equivalent licensing qualification, this is driven by an almost mandatory requirement in order to gain liquor licenses. Where legislative compliance is not so well policed the industry does not fair as well with only 81% holding a Basic Food Hygiene certificate. This fell to 12% at Intermediate level and 7% at Advanced Level. Even where premises described themselves as 'pubs with food', (133 businesses), only 15 had Advanced Level food hygiene qualifications. Basic Health and Safety certificates, essential though not compulsory in UK businesses, were held by only 33% of respondents.

It is not just in qualifications that licensees are endangering their business through non-compliance with the law. Procedures in employment law, such as the issuing of contracts of employment, are not being followed with only 54% of businesses producing them for full time staff. However it is not misinformation that pervades the industry; One tenant says "there is too much new crap, I have just given up", another agrees saying it is too much to do try to comply with such requirements.

Product knowledge is essential in the industry. Major growth has been noted in the sale of wine (Mintel, 2000). It is now a major product in many pubs especially to accompany the sale of food. It is surprising then that only 4.2% of respondents have taken the Wine and Spirit Education Trust qualifications in helping them to support such wine sales. It is an area of consumerism where the supermarkets are investing heavily both in imparting knowledge to customers and also providing exceptionally good value for money. Quality standards in the product are therefore expected to rise and

licensed retailers need a particular type of knowledge to be able to maximise sales in this area. Training can help them to achieve this knowledge.

Planning processes for business success faired a little better. 72% of respondees have a business plan however only 97 businesses or 45.1% of the sample have looked ahead 3-5 years to produce a strategic plan. In these difficult economic times this may seem short-sighted for most licensed retail businesses but Morrison et al (1999) do not see this as a failing in entrepreneurial activity. Rather it is a positive element allowing them to react quickly to change. 27.4% of responders have an annual marketing plan in order to promote their business objectives and nearly 15% have a 3- 5 year plan.

This thought-provoking study shows that three-quarters of all businesses have planning procedures for the development of their businesses but only 78 businesses, or 36% have training plans. With training already being proved as a vital part of the business development function (Armstrong, 2001, Adcock et al, 1998, Billson, 1998), it is staggering to find that this clear link between business success and training strategies are missing.

The study also shows that only 14% of the TLFO have formal recruitment and selection plans. With Meudall and Rodham (1998) and Lashley and Rowson (2000) both suggesting that solutions to industry problems could be found in better selection procedures it is vital that better processes are used in the initial employee contact process. This could include job descriptions, job specifications and induction procedures (Armstrong 2001).

There were some oddities in response. One TLFO said they did not have recruitment and selection processes but went on to describe documentation that they had as including job specifications and job descriptions. This suggests a definition of recruitment and selection plan could perhaps have been given to clarify the question and also shows ignorance in using too pedagogic a language structure within the questionnaire.

What of the staff and their issues? Personal wellbeing may or may not include training, and for some it is expected that the employee themselves would request or seek self-development (Foster & Saunders in Hawkes, 2001),

but that this will include appraising staff on a one to one basis. With only 31.6% of businesses acknowledging they have staff appraisal procedures, this leaves nearly 70% of licensed retail operators not knowing whether their staff wants to develop within the business, and without a clear plan to integrate it into the business's future.

Gerber (1996) and Monk (1996) both put businesses under the microscope in investigating appraisal procedures, placing training and care of staff to the forefront in motivating them. No wonder one of the biggest competitors and winners for traditional groups of licensed retail sector staff are the supermarket retailers – they have a 100% appraisal process and widely developed training programmes.

There is a judgement that the licensed retail sector are just not competing for the best staff but it is important to note that 42.8% of licensees use training as a tool in attracting staff through advertising medium. As well as this, 83.7% discuss training as a positive benefit from the employment during the interview process. This contrasts with the actions of licensees; only 30% of licensees' link training to pay incentives. Such tools can be inventive in changing the culture and perceptions of training by staff (Palmer, 2003 i) and this would be immediately useful in those 57.2% of staff who show a lack of interest in training because they are doing it as a part time job.

Overall TLFO feel training is vital so that staff know how to do their jobs; all respondees agreed or agreed strongly with this statement. Moreover some TLFO feel training is a crucial factor in enabling them to make greater profits from the business. Therefore with 79.1% of TLFO feeling that training is an important benefit to offer within the licensed retail sector it is gratifying to note that most licensees feel it is something that they do in their businesses every day.

The most popular method of training staff is in-house by either self or a supervisor (82.3%). According to Billson (1998) this is the most effective method of training to fulfil business objectives, therefore, TLFO are acting in the right regard to training by using this method. In using in-house training though it is imperative that the trainer must be able to train (Armstrong, 2001) and must be competent to pass on correct information (Barnett, in Boud &

Garrick, 1999). Only 5% of respondees indicated they had training qualifications.

TLFO have also shown that they are lacking in qualification in knowledge of H&S, Food Safety and other legislative requirements. It must therefore be considered that if this in-house method is used to deliver knowledge for the compliance of legal obligations licensees may be susceptible to a lack of 'due diligence' defence in the case of prosecution, (Croners, 1994). In support of this defence a quarter of all businesses have written policies to cover the main areas of legislation.

Despite over a third of businesses giving opportunities to communicate through staff meetings on a regular basis overall the study showed a culture of 'them and us' when it comes to discussing staff. The qualitative responses given in the "training wish list" at the end of the questionnaire show that a quarter of all TLFO feel that staff need to give more to them rather than the TLFO engendering a team spirit in staff. This shows a lack of human resource management knowledge that needs to be tackled by the sector.

It was expected that more TLFO would highlight training as being able to 'grow the business' or that training staff meant that the owner/operator could take more time off but except in a very few cases, less that 1%, these were not cited as benefits. The pilot studies, in contrast, showed that these were major factors in developing substantial training investments. One business showed that instead of one premises he could develop two and now three, and another investing in a second and strongly considering a third, as a direct result of taking training seriously (LR003 & LR005, 2003).

The benefits of training highlighted by TLFO relate to what Lashley & Best (2002) describe as a short-termism approach. Immediate bottom line considerations are shown to dominate, as TLFO demand staff be "willing", "motivated" and "committed" without investing in structures to enable this to happen.

6. CONCLUSION

The On-licensed retail sector needs to wake up the benefits of investing in its people in order to achieve competitive advantage and commercial success. The industry as a whole has shown a huge growth but will not continue to do so unless it differentiates its business and provides excellent customer service. To do this the training philosophy of its small and micro businesses must change.

TLFO are bright people in a dynamic industry. Whilst most TLFO have a high standard of school education, and some have furthered their learning by taking undergraduate degrees, there is a limited application to training oneself for the industry in which the business operates.

Product knowledge and legislative compliance tests have shown lack of continuos self-development and awareness amongst respondents. Some TLFO have acknowledged this lack with more than one respondees saying, "I wish I could start again knowing what I do 18 years on" and 3% decrying their lack of financial and business knowledge. Others quote a lack of cellar and stock control expertise. More vehement respondees say: -

"This industry employs too many non-qualified people"

"Too many enter with little or no experience"

As Lashley (2001) observed it is down to pub companies to help to change the attitudes of this dynamic of the industry. "No help was given by the brewer", and "working with a pub company is confusing", show that some in the industry are not helping their prospective tenants to really understand the business they are going to enter. Pub Companies could look to the more relaxed approaches that licensees take to self development, reading trade press, internet access, TV and training videos and develop a different approach to that of the "course route". One such training idea could be the use of business games, perhaps in competition with other publicans, in order to develop management techniques (Forsyth, 1999 & 2000).

Staff morale and motivation is a big issue for TLFO. This is highlighted in the comments suggesting that their wish list is for:-

- committed and motivated staff (3 respondees),
- staff who want to work (2 respondees) and
- staff who stay on a long-term basis.

Improved staff response may be gained if licensees used training as a carrot, rather than a stick, and linked training to pay incentives and other benefits. After all "there are two ways to make someone want to do something – the positive approach in a friendly atmosphere to help a person gain an increase in satisfaction, and the more negative method…….through fear and danger" (Monk, 1996, p. 27).

The study supports the findings that there are limited motivational tools in place to keep and maintain staff morale and stimulation over and above that which is provided by pay structures (Jerome & Kleiner, 1995). As Torrence (1993) says "Trainees need to be rewarded for learning. Smiles, positive body language and words of encouragement are powerful psychological tools" (in Monk, 1996, p.2). The commentary provided by TFLO in this study show these are sadly lacking in the majority of the sector.

Whilst most licensees see that there is more to training than legislative compliance and do not see training as a waste of time and money there is enough deviation to show that attitudes are not strong even from members of the professional body. Given the limitation of the study we can extrapolate these results to show that whilst training is given lip service the licensed retail sector does not have an exemplary training philosophy, , however it is not all bad and there is evidence of some exemplary practise.

Overall licensees opt for methods of training that are easily accessible. In doing so they are allowing themselves to be subject to dangers from prosecutions brought when employees or customers have accidents on their premises or dangers from prosecutions brought by the local authority due to non-compliance in specific training areas.

There is a gap in usage of such 'soft' methods of training as TV and CD-ROM that could be easily accessible and can be used in both legislative and other areas of training. One episode of Eastenders would provide a litany of illustrations, which can be used as case studies and scenarios, and 'The Pub Channel' provides an equal amount of training materials.

Employees are comfortable with such methods of training, which is illustrated through their extensive use. When external courses are broached factors such as part time work, careers, benefits and ability to succeed become worrying factors, which will cause training to fail in its objectives.

Training brings benefits and TLFO acknowledge this. These range from financial benefits to increased customer service. However the gap in acknowledging how training can bring benefits in terms of staff satisfaction and motivation and thereby help to retain trained staff in the TLFO business is disappointing. It, combined with the lack of evaluation, shows that the ad hoc approach to training is pervasive in the industry and this is underpinned by a lack of knowledge of human resource management. By linking some of the 'softer methods' of training which employees and employers seem to have little difficulty with, into a more formal approach to training, by the use of training plans and staff appraisal, some of the effects of training may be illustrated and allow success to be measured.

All is not doom and gloom however. With 40% of businesses using a planned evaluative approach and 30% linking pay incentives to training there is a move toward a culture change that, once barriers to training are removed, will grow. Accessibility of courses and funding will help to reduce the financial burden of training on businesses. Whilst the financial burden cannot be removed altogether, and indeed "free training" has been proved to be unworthwhile (BII, 2000) short courses or e-learning, delivered on site, will be welcome by most TLFO.

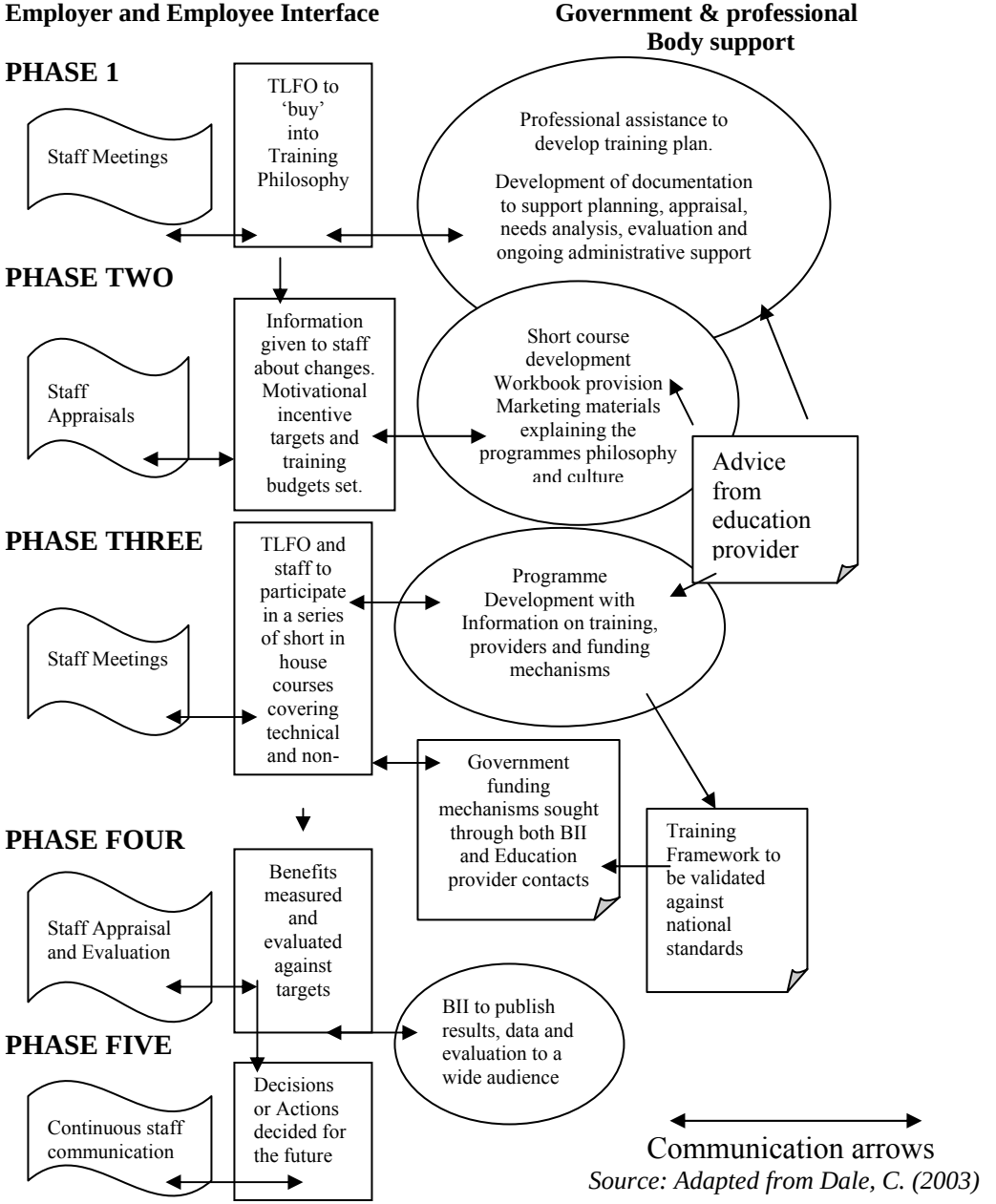
Ultimately the discourse is about communication. Communication from the providers of education and training to the industry operators and back again; communication from industry operators to their staff and back again; and communication from funding mechanisms throughout the progression.

TLFO have requested "communication skills" as a subject specific course that is needed for their personal development. The commentary on staff within the qualitative commentary would seem to indicate it is much needed but developing a change in culture needs a top-down approach that requires systematic development (Dale, 2003), in this case a structured approach to training by all stakeholders.

The illustration, (see figure 6), shows an effective training framework driven primarily by business needs offering developmental and funding support in order to change the cultural paradigm of the sector. Such solutions have been used in other industries. Egg, for instance, the e-commerce banking organisation, developed a partnership with Harris Associates, called 'Stepping Out' that developed a blended learning project using an effective mix of different learning methods "to optimise the effect of all of them" (Bagshaw & Bagshaw, 2002).

The industry needs this type of development; it looks forward to implementation.

FIGURE 6: A TRAINING FRAMEWORK: UTOPIA – NO JUST COMMITMENT!



Source: Adapted from Dale, C. (2003)

REFERENCES

Adcock, D., Bradfield, R., Halborg, A., and Ross, C. (1998). *Marketing Principles and Practice,* 3rd Ed. London: Financial Times.

Armstrong, M. (2001). *A Handbook of Human Resource Management Practice,* 8th Edition. London: Kogan Page.

Ashton, D., and Felstead, A. (1995). *Training and Development* in Storey, J. (ed.). *Human Resource Management: a critical text,* London: Routledge.

Axtell, C.M., Maitlis, S., and Yearta S.K., (1997). Predicting immediate and longer-term transfer of training, *Personnel Review,* Vol. 26, No.3, 201-213.

Bagshaw, M., and Bagshaw, C. (2002). Radical self-development – a bottom up perspective, *Industrial and Commercial training,* Vol. 34, No. 5.

Becker, H.S. (1965). Review of P.E. Hammond's Sociologists at Work, *American Sociological Review*, Vol, 30, 602-603.

Billson, I. (1998). How just in time training can support business led competency development, Competency, Spring, 21-24 in Armstrong, M. (2001), *A Handbook of Human Resource, Management Practice,* 8th Edition, London: Kogan Page.

Bommer, M., O'Neil, B., and Treat, S. (2002). Strategic Assessment of the supply chain interface: a beverage industry case study, *International Journal of Physical Distribution and Logistics,* Volume 3, No. 1, 11-25.

Boud, D., and Garrick, J. (eds.). (1999). *Understanding learning at work,* London: Routlege.

Bray, J. (2002). Virtual tutoring in hospitality – a "learnt system" of professional practice, *International Journal of Contemporary Hospitality Management,* Vol. 14, No. 1, 21-27.

British Institute of Innkeeping (2000). *Report on Better Business Initiative,* (Unpublished data).

Buchanan, D. A., Boddy, D., and McCalman, J. (1988). *Getting in, Getting on, Getting out and Getting Back,* in Bryman, A. (ed.), *Doing Research in Organisations,* London: Routledge.

Campbell, C.P. (1994). A primer on determining the cost effectiveness of training – Part 1, *Industrial and Commercial Training,* Vol. 26, No. 11, 32-38.

CAMRA, (1998). Rural Pubs, *Ale,* No. 292, November.

Chatrik, B. (1999). *Guide to training and benefits for Young People,* London: Unemployment unit and Youthaid.

Clarke, I., Kell, I., Schmidt, R., and Vignall, C. (2000). Thinking the thoughts they do, *British Food Journal,* Vol. 102, No. 9, 692-710.

Croner, (1994). *Croner's Management of Public House,* Southampton: Croner Publications & British Institute of Innkeeping.

Dale, C. (2003). Getting over technophobia: developing a culture of technology supported learning in hospitality, leisure, sport and tourism, *LTSN Learning and Teaching Support Network*, Issue No. 7, Summer 2003.

Dewhurst, H., Livesey, R., Dewhurst, P., and By, R. (2002). *A Skills and Training Needs Analysis of the Shropshire Tourism Industry,* Walsall: University of Wolverhampton.

Drejer, A. (2000). Organisational learning and competence development, *The Learning Organisation,* Volume 7, No.4, 206-220.

Eaglen, A., Lashley, C., and Thomas, R. (1999). *Benefits and Costs Analysis: The Impact of training on business Performance,* Leeds: Leeds Metropolitan University.

Ford, J.K., Quinones, M., Sego, D., and Sorra, J. (1992). Factors affecting the opportunity to perform trained tasks on the job, *Personnel Psychology*, Vol. 45, 511-527.

Forsyth, H.A. (1999). *The National Innkeeping Business Game (1989-1997); Professional Development on a national scale,* in Saunder, D., and Severn, J. (ed). (1999), The International Simulation and Gaming Yearbook, Vol.7, Simulations and Games for Strategy and Policy Planning. London: Koogan Page.

Forsyth, H.A. (2000). *The role of benchmark pre-computed National Catering Business Games (NCBG) in encouraging effective business decisions and lifelong learning,* in Saunder, D., and Severn, J. (ed), (2000). The International Simulation and Gaming Yearbook, Vol.8, Simulations and Games for Transition and Change, London: Koogan Page.

Forsyth, A., and Goodwin, M. (2002.) *Games and Simulations; their added value to negotiated work-based learning (NWBL) and emotional competence development,* Knowledge, Work and Learning Conference, Work Based Learning Network of the Universities Association for continual education, 27th and 28th November 2002, University of Cardiff.

Gerber, R. (1998). How do workers learn in their work*? The Learning Organisation,* Vol.5, No.4, 168-175.

Gill, J. and Johnson, P. (2002). *Research Methods for Managers,* 3rd Edition, London: Sage Publications.

Grieve, P. (2003). *Personal communication,* Enterprise Inns head office, Solihull, 2nd May 2003.

Hankinson, A., and Bartlett, D. (1997). The key factors in the small profiles of small-medium enterprise owner-managers that influence business performance – The UK (Rennes), SME survey 1995-1997, An international research project UK survey, *International Journal of Entrepreneurial Behaviour and Research,* Vol. 3, No. 3.

Harman, N. (2003). *Personal Communication,* Wessex House, Camberley, 23rd July, 2003.

Hawkes, J. (2001). *Work based learning – AS vs Scholar and customer, models and implementations,* Work Based Conference proceedings, 22nd – 23rd November 2001, Work cased Learning Network of the Universities for Continuing Education.

Heskett, J.L., Jones, T.O., Lovemena, G.W., Sasser, W.E., and Schlesinger, L.A. (1994). Putting the service-profit chain to work, *Harvard Business Review*, March-April, 164-74.

Home Office. (2000). *Time for reform: proposals for the modernisation of our licensing laws,* London: The Stationary Office Ltd.

Hospitality Training Foundation. (1996). *Training: Who needs it?* London: Hospitality Training Foundation.

Hospitality Training Foundation. (1999). *Look who's Training now,* London: Hospitality Training Foundation.

Hospitality Training Foundation. (2000). *Skills and Employment Forecasts 2000,* London: Hospitality Training Foundation.

Hospitality Training Foundation, (2001 i). *Labour Market Review 2001,* London: Hospitality Training Foundation.

Hospitality Training Foundation. (2001 ii). *The Workforce Development Plan,* London: Hospitality Training Foundation.

Huang, T. (2001). The relation of training practices and organisational performance in small and medium size enterprises, *Education and Training,* Vol. 043, No. 8/9, 437-444.

Hutt, C. (2002). Inn to the Future, *The Publican Newspaper.*

Jerome, L. and Kleiner, B.H. (1995). Employee morale and its impact on service: what companies do to create a positive service experience, *Managing Service Quality,* Vol. 5, No. 6.

Knowles, T. (1996). *Corporate Strategy for Hospitality,* Longman: Essex.

Lange, T., Ottens, M., and Taylor, A. (2000). SMEs and barriers to skills development: a Scottish Perspective, Journal of European Industrial Training, Vol. 24, No. 1, 5-11.

Lashley, C. (2001). *Selecting and Supporting tenants and licensees in licensed retailing, 'Is there breath on the mirror?'* Leeds Metropolitan University, Unpublished data.

Lashley, C., and Best, W. (2002). Employee induction in licensed retail organisations, *International Journal of Contemporary Hospitality Management,* Vol. 14, No. 1, 6-13.

Lashley, C., and Rowson, B. (2000). *Wasted millions: staff turnover in licensed retailing,* Proceeds of 9th Annual CHME Research Conference, University of Huddersfield.

LeCompte, M.D., and Goetz, J.P. (1982). *Problems of Reliability and Validity in Ethnographic Research,* Review of Educational Research, New York: Free Press.

Lin, B., and Darling, J. (1997). A processional analysis of customer service training, *Journal of Services Marketing,* Vol. 11, No. 3.

Lincoln, G. (2003). *Personal Communication,* The Swan Hotel, Stafford, 3rd June 2003.

Lindeman, E.C. (1926). *The meaning of adult education,* New York: New Republic.

Loftland, J., and Loftland, L.H. (1984). *Analysing Social Settings: a guide to qualitative observation and analysis,* 2nd Edition, Belmont: Wadsworth.

McNammarra, J. (2003). *British Institute of Innkeeping AGM,* Birmingham College of Food, 30th June 2003.

Macrae, C. (1996). Re-thinking brand management: the role of "brand chartering", *Marketing Intelligence & Planning,* Vol, 14, No. 7.

Matlay, H., and Hyland, T. (1997). NVQs in the small business sector: a critical overview, *Education and Training,* Vol. 39, No. 9, 325-332.

Mayo, G.D., and Dubois, P.H. (1987). *The Complete book of training: theory, principles and techniques,* San Diego: University Associates.

Meudell, K., and Rodham, K. (1998). Money isn't everything…or is it? A preliminary research study into money as a motivator in the licensed house sector, *International Journal of Contemporary Hospitality Management,* Vol. 10, No. 4, 128-132.

Miles, M., and Huberman, B. (1994). *Qualitative Data Analysis,* 2nd Ed. London: Sage

Mintel, (2000). *Wine Retailing,* Mintel International Group Limited.

Mintel, (2002 i).*High Street Pubs and Bars,* Mintel International Group Limited.

Mintel, (2002 ii). *Pub Visiting,* Mintel International Group Limited.

Mintzberg, H., Ahlstrand, B.W., and Lampel, J. (1998). *Strategy Safari: a guided tour through the wilds of strategic management,* London: Prentice Hall.

Monk, R. (1996). The motivations of managers for training, *Management Development Review,* Vol. 9, No. 3, 26-32.

Morgan, G. (ed.) (1983). *Beyond Method,* London: Sage Publications.

Morrison, A., Rimmington, M., and Williams, C. (1999). *Entrepreneurship in the Hospitality, Tourism and Leisure Industries.* Oxford: Butterworth Heinemann.

Mühlemeyer, P., and Clarke, M. (1997). The competitive factor: training and development as a strategic management task, *Journal of Workplace Learning,* Vol. 9, No. 1.

Neville, A. (2003). *Personal Communication,* University of Wolverhampton, 21st May 2003.

Oppenheim, A.N. (1996). *Questionnaire design and attitude measurement,* London: Heineman.

Palmer, A. (2003 i). Growing demand for new qualifications, *biibusiness,* Issue 115, April 2003.

Palmer, A. (2003 ii). Winning the big one! *Biibusiness,* Issue 115, April 2003.

Pratten, J.D. (2001). Violence in the Licensed Trade – Are staff trained to combat this problem? *The International Journal of Applied Human Resource Management,* Vol.2, No.3.

Pratten, J.D., and Soffield, S. (2002). A Market Analysis of the Licensed Retail Trade, *Management Research News,* Vol. 25, No. 4, 1-11.

Preece, D., Steven, G., and Steven, V. (1999). Work, Change and Competition in Pratten, J., and Lovatt, C. (2002), Can the rural pub survive? – A Challenge for Management or a lost cause, *Management Research News,* Vol.25, No.1.

Pub Industry Handbook, (2003). *Pub Industry Handbook,* Croydon: Quantum Publishing Ltd for Publican Newspapers.

Publican Newspapers, (2001). *The Pub Goers Survey 2001,* Croydon: Quantum Publishing Ltd for Publican Newspapers.

Publican Newspapers, (2002). *Conference and Speakers Notes,* Croydon: Quantum Publishing Ltd for Publican Newspapers.

Read, C.W., and Kleiner, B. (1996). Which training methods are effective? *Management Development Review,* Vol. 9, No. 2, 24-29.

Robson, C. (1993). *Real World Research: A resource for Social Scientists and Practitioner Researchers,* Oxford: Blackwell Publishers Ltd.

Sims, R.R. (1990). *An experimental approach to employee training systems,* Westport: Quorum Books.

Stebbins, R.A. (1987). Fitting in: the researcher as a learner and participant, *Quality and Quantity,* Vol. 21, 103-108.

Stokes, A. (2001). Using telemonitoring to deliver training to SMEs: a pilot study, *Education and Training,* Vol. 43, No 6, 317-324.

Stoy Hayward, (1996). *A study to determine the reasons for failure of small businesses in the U.K.,* London: Stoy Hayward.

Thomas, R., Lashley, C., Rowson, B., Xie, G., Jameson, S., Eaglen, A., Lincoln, G., and Parsons, D. (2000). *The national survey of small tourism and hospitality firms: 2000 skills demand and training practises,* Leeds: Centre for the Study of Small Tourism and Hospitality Firms, Leeds Metropolitan University.

Wiscombe, W.C. (2002). Personal Communication, The Pilot Boat Inn, Lyme Regis, 18th November, 2002.

Wiscombe, W.C. (2003). Personal Communication, The Pilot Boat Inn, Lyme Regis, 23rd March, 2003.

The Cyprus Journal of Sciences, Vol. 3, 2005/225-247

INFORMATION SERVICES OFFERED THROUGH THE HOTEL WEB SITES: A COMPARATIVE STUDY BETWEEN CYPRUS AND GREECE

COSTAS ZAFIROPOULOS* and VASILIKI VRANA**

ABSTRACT

Information provided through the hotels web sites can serve as a means for improving marketing and eCommerce for tourism companies. The article uses a conceptual framework which categorizes a wide range of offered information services into seven categories: Facilities information, Customer contact information, Reservation-price information, Surrounding area information, Management of the website, Company information and Communication. Also the property of interactivity is taken into account for the study of each category. A case study of hotels in Cyprus and Greece reveals differences in types of information services provided through the hotel web sites between these countries. Greek hotels mainly provide general and contact information while Cypriot hotels lead in providing reservation and area information services. Hotel class and chain membership have an effect on the volume of offered information in both countries but to different degrees.

Key words: hotel web sites, information services, information dimensions, interactivity, Cyprus, Greece

1. INTRODUCTION

Information and Communication Technologies (ICT) crucially impact on travellers' knowledge, attitudes and behaviour. The increased online price/product transparency and the new e-business models enhance tourists' purchasing power, who are becoming more price sensitive, less brand loyal, more sophisticated and experience seekers (Sigala and Christou, 2002; Sigala

* Assistant Professor, Department of Business Administration, Technological Educational Institute of Serres, Greece

** Adjunct Professor, Department of Accounting, Technological Educational Institute of Serres, Greece

2003a; Christou, 2003a; Christou and Kassianidis, 2003). Gratzer and Winiwarter (2003) argued that for the accommodation sector the web is a perfect platform to bring information about their products to the customers all over the world, in a direct, cost minimizing, and time effective way. Sigala (2003c) argued that e-commerce is usually presented as an opportunity for Small and Medium Tourism and Hospitality Enterprises because it helps reduce transaction/commission costs and level the playing field. Often cited benefits include expanding the scope of marketing, wider and richer communications, relationship building, reaching new markets, reducing the cost of operations and partnering with suppliers and other collaborators.

Consumers can undertake their entire tourism product search and booking online and therefore, they require flexible, specialized, accessible, interactive products and communication with tourism organizations (Garces et al., 2004). In response to the increasing demand for hotel e-business, many hotels have already established websites to promote their services and products, and eventually gain a share of online market (Weeks and Crouch, 1999; Morisson et.al., 1999). A well designed site ensures the most cost effective entry into an electronic distribution universe (Scoviak, 2003). Effective information distribution is important since consumers are dependent on accurate, timely, high quality information to help differentiate among competing properties (O'Connor and Frew, 2004; Poon, 1994). Convenience, both in terms of finding appropriate information and facilitating reservations and payment process is also critical (O'connor and Frew, 2004; Castleberry and Hempell, 1998).

Sigala (2003a) stated that one of the three features of the virtual marketspace is richness. Information richness refers to the "quality of information" in the view of the users, accuracy, bandwidth, currency, customisation, interactivity, relevance, security and others. The concept of information richness can be used to describe the nature of information and taken as another decisive factor for the typology of tourism related web sites, since tourism web sites vary tremendously regarding their information richness, and accordingly the design and use of their web sites differ significantly (Pan and Fesenmaier, 2000). Froehle and Roth (2004) claimed that one could assess the media richness of a technology-based medium by assessing how closely it approximates the richness of face-to-face

communication experience. Sigala (2003a) stated that richness occurs because information flow is greater, deeper and faster than it is in the traditional market. As buyers have more product/service information, transactions' transparency amongst prices and vendors increase.

Many marketers consider the web to be the fourth marketing channel because of its potential to attract, engage and involve visitors. This is not to say, however, that a simple web presence can achieve all of its potential: a web site must deliver several essential features to foster a better online experience. Research has shown that interactivity engages users. Other benefits of adding interactivity to a web site include improved user satisfaction and a possible increase in site visibility, hence better acceptance (Chen and Yen, 2004). Interactivity is defined as "the extent to which users can participate in modifying the form and content of a mediated environment in real time" (Steuer, 1992). Hopkins et al. (2004) theorized interactivity as one of the two distinct dimensions of telepresence. Rice and Williams (1984) indicated that the study of interactivity should focus on the nature of the real time communication, while recent research have acknowledged the existence time lag in computer-based interactivity, suggesting that some interactivity may not occur in real time. For example email, newsgroups and mailing lists are all asynchronous features of modern interactive media. Asynchronous interactivity does not necessarily deteriorate the quality of their communication, but can actually facilitate the desired effect (Chen and Yen, 2004). Automated e-mail interactions with customers may improve customers' service and service efficiency and integrate e-mail, telephone and web interfaces (Sigala 2004a). Christou (2003b) claimed that interacting with customers and satisfying customers needs are vitally important while Sigala (2004b) stated hoteliers heavily collect guest information by observing and interacting with guests and then store data into books and other files.

The present study was designed with two research objectives:

- To investigate to which extend hotel websites provide information features; and
- To analyze the websites in terms of interactivity.

Cypriot and Greek hotels are the cases on which a theoretical framework is applied. Tourism is a vital industry for the countries in the Mediterranean (Falzon, 2003). Several countries in the region have relied primarily on tourism to foster the level of their economic growth and development. Cyprus and Greece belong to the same sub region within the Mediterranean, with similar characteristics and offering specific types of vocation experiences, in other words Cyprus and Greece have common tourist situations (Apostolopoulos and Sonmez 2000, Dieke and Karamustafa 2000). Also according to annual Conde Nast Traveller awards, that are widely regarded as the "Oscars" of the tourism industry (http://www.dailymirror.lk/2003/09/15/ft/1.html), for the Year 2003 Greece and Cyprus were rated among the best tourist destinations, more specifically Greece was the tenth best country in the world for tourists (79, 90%) and Cyprus the 20th island (86, 50%).

2. LITERATURE REVIEW

To measure how rich in information hotel websites are, an attempt was conducted by Murphy et al. (1996). They analysed 20 chain hotels and 16 freestanding hotel sites to see what features they contain. They recorded 32 different features that were on those 36 sites. The different features were then placed into four broad nonexclusive categories: promotion and marketing, service and information, interactivity and technology and management. A standardized but personalized e-mail questionnaire was sent to all 36 hotels asking specific questions about their websites experiences. They claimed that Cyber-hoteliers must analyse how these features effect or enhance the mission, margin, mechanics, marketing and maintenance of their websites.

Weeks and Crouch (1999) conducted a similar study to examine the contents of Australian-based hospitality and tourism websites. They modified the features that Murphy et al. (1996) identified, into 33 attributes, and then classified them into four categories. These attributes were then used to analyze 20 websites that were chosen as a sample base, in six hospitality and tourism sectors. A checklist was devised to isolate features within each of the chosen sites. Totals for elements appearing on sites within each industry sector were calculated. Each sector was then analyzed to find differences and similarities of items included in these sites. The Accommodation sector appeared to be less

keen than other sectors to tell its visitors about other accommodation or tourism sites.

Chung and Law (2003) developed a model on the basis of a conceptual framework which consisted of five major hotel website dimensions, including facilities information, customer contact information, reservation information, surrounding area information, and management of websites and their associated attributes. A preliminary study was performed with Hong Kong hotel managers to rate the level of importance of the dimensions and attributes. The model was then applied to initially measure the performance of the websites of Hong Kong hotels. The performance result of a website is expressed by the total performance score of the site. Experimental findings showed significant differences in performance score for all dimensions among the luxurious, mid-priced and budged hotel websites.

Wei et al. (2001) at their survey carried out among the membership of Global Hoteliers, an organization of executives in the international hotel industry, find out that hotel size star rating, and hotel type were among the organization factors which had some significant effect on certain aspects of the information hotels posted on the Web.

Several researches investigated to which extend websites provide information features and make use of the potentials offered for eCommerce. Sigala (2003b) recorded several characteristics from Greek hotel sites as a part of her research, in an attempt to record and valuate the offered services. The recording and analysis of the information services offered from the hotels web sites is a common and useful way to research how informative the web sites are.

Vrana et al. (2004) examined and measured the quantity and type of information provided through hotel web sites. A model was used, based on a conceptual framework, which consists of seven major hotel website dimensions. The managerial features of the businesses: star rating, size and chain member were taken into consideration. It was found that the Athens hotels used in the study do not make maximum and uniform use of the possibilities offered to attract customers through the web information services.

Higher-class hotels as well as chain hotels appear to be more active in offering information services.

Information services provided through the web allow hotels to improve communication, marketing and e-Commerce. Zafiropoulos et al. (2004) using an extend web survey, in their study, identified which information services are offered through the Greek hotel web site; while recording users' attitudes, it estimated the significance rates of the information services. Statistical analysis produced clusters of information services, which were studied according to their size, occurrence, and significance. They concluded that Greek hotel web sites are primarily designed to serve as electronic brochures and while they generally satisfy most of the users' needs, they partly serve as online transactions media, a function considered significant by the users.

Baloglu and Pekcan (2004), in their study utilized content analysis to analyze the websites of a selected group (4- and 5-star) of hotels in Turkey in terms of site design characteristics (interactivity, navigation and functionality) and site marketing practices on the Internet. Their study also investigated variation in design and use of marketing elements on the Internet based on hotel type (4- and 5-star resort and transient hotels). The findings showed that the hotels in Turkey are not utilizing the Internet to its full potential and effectively e-marketing their hotels regardless of the hotel type.

3. METHODOLOGY

This article aims to study and measure the quantity of information offered through the hotel web sites, and compare hotel web sites between Cyprus and Greece. Rich in information web sites may be considered to enhance tourism infrastructure and so it is of interest to explore its current status and potential.

At the first step information services offered on the hotel websites were recorded through an extensive web search. An effort was made to include as many information services offered worldwide as possible. The top 10 hotel groups and top 20 hotel brands were selected according to the Hotels magazine corporate 300 ranking (Hotels magazine, July 2003) and the Hotel-Online Special Report Annual Worldwide Ranking of Hotel Groups and Hotel Brands

(2003), since top hotels can be regarded as most active in the web (for a similar approach see O' Conor, 2003). The survey resulted to the creation of a "universal" set of 66 information services. The limitation of the abovementioned procedure is that the list of 66 information services was not validated in order to distinguish the most significant information services within it. Instead a "complete" list of services was formed in order to capture every information service offered on the web sites. Internet search for the identification and study of online practices is heavily found in the literature (Sigala, 2003b).

Following a methodology similar to that of Chung and Law (2003), this 66 information was divided in seven categories according to their thematic similarity: Facilities information, Customer contact information, Reservation-price information, Surrounding area information, Management of the website (in terms of maintenance, administration and web site design), Company information and Communication (Table 2).

Next, web pages were examined regarding interactivity. Following Baloglu and Pekcan (2004) and Chen and Yen (2004) the interactive features from the list of the 66 information services were identified (Table 2). Since the 66 were grouped according to their thematic similarity, to seven information dimensions, each dimension could be regarded to be composed from two components, the interactive and non interactive one.

An analysis similar to this performed for the dimensions, was implemented for the interactive and non-interactive components in every dimension, as well.

Next, a web search in order to record hotel web sites in Cyprus and Greece was performed. Greek Travel Pages (GTP) was used to identify Greek hotels that have a web site. GTP is considered to be the most comprehensive directory of Greek Tourism. A total of 798 hotel web sites were visited. The official published directory of the Cyprus Tourism Organisation provided information for the Cypriot hotels. A total of 174 hotels were visited.

The final step involved the identification of information services, which are offered through the recorded web sites.

4. A DESCRIPTION OF THE MANAGERIAL CHARACTERISTICS OF THE HOTELS

Previous studies demonstrated that managerial characteristics of the hotel companies, such as the hotel class and chain membership are positively correlated with the amount of information offered through the hotel web sites. O' Connor (2003, p. 91) stated "that major international hotel chains' electronic-distribution activities are indicative of industry patterns, because recent research has shown that large companies are most active on the web - perhaps because their size often gives them an advantage in terms of technical expertise and financial resources." Thus, it is interesting to include in the analysis the study of managerial characteristics of the hotels, such as hotel class and chain membership.

Table 1 presents the hotel class frequencies for the recorded hotels in Cyprus and Greece. In Cyprus, the majority of hotels belong to A and B class (total 84.2%). One tenth of the hotels are class A hotels. Only 6.1% belong to class C while there are not any recorded hotels in classes D and E. Recorded hotels in Greece present a more uniform distribution. A 17.7%, that is twice the percentage of Cyprus, belong to class L. 67.3% of the hotels belong to classes A and B. 14.3% of the hotels belong to class C.

TABLE 1: DISTRIBUTION OF RECORDED HOTELS ACCORDING TO CLASS CATEGORY

Class	Cyprus	Greece
L	9.7%	17.7%
A	41.2%	42.1%
B	43.0%	25.2%
C	6.1%	14.3%
D		0.3%
E		0.4%
N	174	798

Regarding chain membership, Greece and Cyprus demonstrate two completely different patterns. Less than one third of the hotels in Greece

(31.2%) belong to some hotel chain. On the other hand the majority of the hotels in Cyprus are chain hotels (67.8%).

5. FINDINGS

Table 2 presents the 66 information services with their occurrence percentages for Cyprus and Greece. Fisher's exact tests were used to distinguish significant differences between the two countries. Greek hotels offer to a higher degree, through their web sites, most of the customer contact information, general description and reception information, area short description, video and use of several languages. The latest is true because most web sites in Cyprus are presented solely in English. In conclusion, Greek hotel web sites demonstrate to higher degree contact and brochure information. Cypriot hotels offer to higher percentages reservation information (online availability, book online, secure reservation), hotel facilities and surrounding area facilities, company and partners' information, announcements and newsletters. While Greek hotel web sites serve as a means for advertisement and contact, the Cypriot hotel web sites seem to have stepped ahead demonstrating their use for making online business. The latest seems to be indicative of the chain hotels lead. Chain hotels, which prevail in using technology, dominate the Cyprus hotel industry. In this way Cypriot hotels offer more sophisticated online techniques and services.

In Table 2 features (information services) are distinguished in interactive (I) and non-interactive. In this way, and following the seven dimensions framework, each one of the seven information dimensions has two components: one formed by the interactive features and one formed by non-interactive features.

The purpose of this study is to quantitatively measure the performance of the hotel websites in the context of the sites' information richness. After recording as many information features presented through the hotel web sites, a large checklist was formed to serve as a universal set of information features. If hypothetically a hotel web site offered all the recorded features this would be a hotel web site with the richest information offered. Additionally, since the features were separated into seven dimensions, one could see whether a

specific hotel web site offered all or some of the recorded features for every dimension. And the same should easily carry out for each component in every dimension. Table 3 presents the rendered services of the seven dimensions. They are presented in the form of percentages for both Cyprus and Greece and they have been formed in the following manner: For every hotel, the amount of offered services was added for each dimension and then it was divided by the total of services of every dimension. This ratio is expressed as a percentage of the services rendered by the hotel for this specific dimension. If for example, this percentage is 50%, the hotel offers half of the services that constitute a specific dimension. A restriction of this application is that the whole of the recorded features is used as a base. No valuation of the features has been made, that is the features are not distinguished from each other according to their significance, frequency or the opinion of an expert. All features are included, each one having the same weight, from the universal set of recorded offered information features through the hotel web sites.

T-tests were performed in order to examine which dimensions differentiate significantly between Cyprus and Greece (Table 3). Only 'management of the web site' does not differentiate significantly. Both countries provide these information services to the same degree that is an average of 25% of the information services of the dimension are provided through their hotel web sites. Dimension 2 'customer contact information' is provided to higher degree in Greek hotel web sites. More than half of the information services of this particular dimension are offered in Greek hotel web sites. For all the other dimensions, Cypriot hotels are leading. 'Facilities information', is the information richest dimension. More than half of the relative services are provided both by Greek and Cypriot hotel web sites. Information services in 'surrounding area information' are provided to a moderate degree. Nearly one third of the services from the specific dimension are provided, with Cypriot hotels leading. 'Reservation-price information' and 'company information' provide their relative information services to a lesser degree, which is about 20%. Information services in 'communication' are provided to the smaller degree, 13.79% of the information services in the specific dimension, in Cypriot web sites and 7.18% in Greek web sites.

In conclusion, the richest dimensions are 'facilities information' and 'customer contact information'. Cypriot hotels are doing better in providing

information in most of the dimensions, while Greek hotels are ahead in providing more information regarding customer contact.

Table 4 presents a further distinction of the features in each dimension with respect to interactivity. 'Facilities information' dimension contains no interactive features component, while 'Customer contact information' contains only interactive features. Commenting on occurrence percentages of interactive and non-interactive components for each dimension, we can say that for 'Reservation and price information' relatively more interactive than no-interactive features are provided. The same holds true for 'surrounding area information' too. On the contrary for 'Management of the web site' and 'Communication', non-interactive features are provided relatively more.

T-tests were performed to distinguish between Cypriot and Greek hotels. The findings reveal slightly different patterns compared with these found by studying the seven information dimensions (Table 4). For example, while 'management of the web site' does not differentiate significantly as a whole, its interactive component does differentiate and is provided to a higher degree by Cypriot hotels. Non-interactive features are also provided more by Cypriot hotel web sites for most of the dimensions.

Interactivity, when present in ever information dimension, differentiates significantly between Greek and Cypriot hotels for all the information dimensions. The only exception is for 'surrounding area information', for which the only interactive feature is the map. Thus there is little evidence, which derives from the use of just one feature, to reach to some conclusion about this component in the specific dimension.

In most dimensions Cypriot hotels provide interactive features to higher degrees than Greek hotels do regarding the same dimensions. Exceptions occur for the interactive components of 'Customer contact information' and 'Communication'. Keeping in mind that when considering the whole set of information features for every dimension, 'customer contact' information' is provided to a higher degree by Greek hotels and it consists only from interactive features, we can conclude that the interactive components follow the same pattern as the dimensions do.

TABLE 2: INFORMATION SERVICES IN HOTEL WEB SITES IN CYPRUS AND GREECE

	Cyprus	Greece	Fisher's exact test significance < 0.05
Facilities information			
General description	85.1	93.0	*
Hotel facilities	87.4	90.6	
Room facilities	89.7	90.4	
Reception facilities	12.1	28.7	*
Activities/entertainment	74.7	49.7	*
Dinning	70.7	48.6	*
Bars	56.9	38.7	*
Conference halls	39.1	29.3	*
Shops/gifts	4.0	7.0	
Customer contact information			
Telephone (I)	86.2	94.0	*
Fax (I)	83.3	94.9	*
Address (I)	86.2	94.5	*
E-Mail (I)	84.5	92.0	*
Conduct form/feedback form (I)	34.5	19.3	*
Claim form (I)		1.3	
Guest book (I)	1.7	8.1	*
F.A.Q. (I)		2.3	
Reservation-price information			
Reservation (I)	65.5	58.1	
On-line availability (I)	38.5	20.4	*
Book on line (I)	37.9	20.2	*
Secure reservation	35.1	21.9	*
For travel agencies	5.7	10.2	
Packages/promotion	23.6	19.7	
Promotion other		7.4	*
Group promotions	4.0	3.3	
Members special	6.9	6.9	

Prices	51.7	53.1	
Offers	14.9	12.5	
Rewards points or miles	7.5	2.4	*
Cards accepted	15.5	10.7	
Currency converter (I)	22.4	5.1	*
Surrounding area information			
Area Short description	76.4	83.8	*
Map (I)	47.7	53.5	
Distances	41.4	49.1	
Ways of transportation	19.0	20.4	
Area interests	37.9	35.0	
Restaurants in area	13.2	3.6	*
Bars in area	13.2	2.8	*
Shopping	13.2	2.1	*
Nearby corporation – facilities	19.0	2.6	*
Weather	52.9	18.8	*
Management of the website			
Web-Cam (I)	0.6	0.5	
Photos-photo album	92.5	87.3	
Video/virtual tour	5.7	21.1	*
Audio	4.6	7.9	
Multilanguage	15.5	60.3	*
Web designer	68.4	58.5	*
Web Host	45.4	41.7	
Last update	3.4	3.3	
Terms of use	17.2	3.8	*
Downloads (I)	9.8	6.9	
Search engines (I)	29.9	3.9	*
Sign in (I)	9.2	11.5	
E-shop (I)			
Help (I)		1.6	
Links to others	32.2	37.0	
Links to partners	69.0	36.5	*

Company information			
Employment	16.1	12.2	
Franchise	1.1	1.0	
About us/brand	61.5	20.8	*
Communication			
Press	2.3	6.1	*
Recommendations	0.6	0.9	
Awards	16.7	9.6	*
Announcements	28.7	11.0	*
Newsletter	33.9	13.7	*
Questionnaire (I)	0.6	1.8	

(I: interactive feature)

TABLE 3: INFORMATION DIMENSIONS IN HOTEL WEB SITES

Dimension	Country	Mean (%)	SD (%)	T	p
Facilities information	Cyprus	57.72	21.42	2.62	0.009
	Greece	52.89	22.16		
Customer contact information	Cyprus	47.05	19.73	-2.39	0.018
	Greece	50.78	12.38		
Reservation-price information	Cyprus	23.52	18.35	3.71	0.000
	Greece	17.99	14.91		
Surrounding area information	Cyprus	33.39	25.70	3.03	0.003
	Greece	27.18	17.50		
Management of the website	Cyprus	25.21	10.91	1.45	0.147
	Greece	23.85	11.23		
Company information	Cyprus	26.24	22.82	7.96	0.000
	Greece	11.32	22.30		
Communication	Cyprus	13.79	15.86	5.00	0.000
	Greece	7.18	15.43		

TABLE 4: INFORMATION COMPONENTS (INTERACTIVE/NON INTERACTIVE FEATURES) FOR EACH DIMENSION

Component	Country	Mean (%)	SD (%)	T	p
Facilities information (interactive features)	Cyprus	0.00			
	Greece	0.00			
Facilities information (non interactive features)	Cyprus	57.72	21.42	2.62	0.009
	Greece	52.89	22.16		
Customer contact information (interactive features)	Cyprus	47.05	19.73	-2.39	0.018
	Greece	50.78	12.38		
Customer contact information (non interactive features)	Cyprus	0.00	0.00		
	Greece	0.00	0.00		
Reservation-price information (interactive features)	Cyprus	41.09	27.00	6.99	0.000
	Greece	25.97	19.51		
Reservation-price information (non interactive features)	Cyprus	16.49	17.95	1.16	0.248
	Greece	14.79	15.27		
Surrounding area information (interactive features)	Cyprus	47.70	50.09	-1.39	0.165
	Greece	53.50	49.90		
Surrounding area information (non interactive features)	Cyprus	31.80	25.09	3.78	0.000
	Greece	24.25	16.99		
Management of the website (interactive features)	Cyprus	8.23	9.60	5.16	0.000
	Greece	4.07	9.76		
Management of the website (non interactive features)	Cyprus	35.40	14.96	-0.25	0.800
	Greece	35.72	15.41		

Company information (interactive features)	Cyprus	0.00			
	Greece	0.00			
Company information (non interactive features)	Cyprus	26.24	22.82	7.96	0.000
	Greece	11.32	22.30		
Communication (interactive features)	Cyprus	0.57	7.58	-1.60	0.000
	Greece	1.75	13.13		
Communication (non interactive features)	Cyprus	16.43	19.08	5.16	0.000
	Greece	8.27	18.05		

6. THE EFFECT OF HOTEL CLASS AND CHAIN MEMBERSHIP

This section aims to explore what the effect of managerial characteristics is on the volume of information services offered through the web. Hotel class and chain membership are main indicators of the managerial status of a hotel. In the analysis they served as two independent variables, which may have an impact on the volume of information provided. The seven information dimensions were regarded as the dependent variables. Multiple linear regression models were applied on these variables for each country separately and once jointly for both countries. Stepwise regression technique was used in order to control for multicollinearity. Table 5 presents only the significant regression coefficients for each model.

Dimension 1, 'facilities information': for Cypriot hotel web sites, class has a significant impact on the amount of information regarding facilities information. Since regression coefficient B is positive (10.14), higher-class hotels offer this kind of information to a higher degree through their sites, while it seems information is uncorrelated with chain membership. The same conclusion about class applies for the hotels in Greece (B=9.6). However for Greek hotels there is evidence that chain membership complementary determines the amount of information in dimension 1 (B=9.85). Chain hotels, regardless of their class, offer larger amounts of information. Considering the

two-countries model, in which country is regarded as an independent variable, class and chain membership determine the volume of facilities information provided, whereas country has no significant impact. This finding does not contradict the findings of Table 3 regarding Dimension 1. While t-test revealed that there is a statistically significant difference between the two countries, regression explores if the effect of the managerial characteristics are the same of at least analogous between the two countries. It seems that even if chain membership effect has a different impact between the two countries, actually it doesn't constitute a systemic difference.

Dimension 2, 'customer contact information': only chain membership has an effect on the volume of customer contact information offered in the web sites, for both Cyprus and Greece. However, the effect for Greece is the opposite of this for Cyprus. Chain hotels in Cyprus provide customer conduct information in smaller proportions than no-chain hotels do, while chain hotels in Greece provide this kind of information in higher degrees than non-chain hotels do. In the "two countries" model it is of interest to notice that the aforementioned difference can now be considered to be a basic difference between the two countries.

Dimension 3, 'reservation-prices information': both hotel class and chain membership has an analogous effect on the hotel web sites of both countries. Higher-class hotels and chain hotels are leading in providing reservation and prices information, because B is positive and significant. This pattern, which is applied in the same manner to both countries, makes the effect of variable 'country' in the "two countries" model to be of no statistical significance.

Dimension 4, 'surrounding area information': although only chain membership has a positive effect on the amount of information provided through the hotel web sites, in both countries, this effect is far more significant for Cyprus than it is for Greece. B for Cyprus is 16.90 while B for Greece is only 6.23. The significant negative B of the two countries model demonstrates the difference between the two countries (-3.866). Hence surrounding area information is a characteristic of the chain hotels in Cyprus.

Dimension 5, 'management of the web site': the effect of chain membership influences positively the web sites in hotels of both countries but

to a different degree. On the other hand, hotel class complementary affects web site information for Greek hotels. These two different characteristics lead to occurrence of the significant B = 1.919 for the country variable in the "two countries" model. Positive B implies that Greek hotels provide more management of web site information.

Dimension 6, 'company information': chain membership affects once again both countries' hotels web sites, while it has a greater impact for Cyprus. Hotel class has a complementary positive important effect on Greek hotel web sites. These differences in parameters effects and degrees imply a systemic difference between the two countries. The "two countries" model reveals this difference by the significant negative B (-11.496). Cypriot hotels present more company information, and this is more intense for chain hotels.

Dimension 7, 'communication': both Greece and Cyprus present the same pattern in providing communication information. In both countries communication information provided through the web sites is positively affected both by class and chain membership. In both countries higher-class hotels and chain hotels provide more communication information.

7. CONCLUSIONS

Information services offered through the web can be summarized to seven information dimensions according to their thematic similarity. In this way some interesting results may be drawn for the capability of the hotel companies to meet customers' contemporary needs and provide the means for informing, contacting and making transactions with them. The seven dimensions framework serves well as a tool for summarizing and describing the status of the offered information through the web, but can also be used as the basis for making comparative studies among different contexts. It was this use that revealed some interesting features regarding the comparison of Cyprus and Greece.

Interactivity is an interesting characteristic of information provision through web sites. When regarded jointly with the seven dimensions framework, it can enrich the findings and help to distinguish and comment both

on the quantity and quality of information features provided. Both countries share common tourist situations and have developed informative hotel web sites. However it seems that each country puts in front different characteristics. Greek web sites promote customer contact information, while they remain behind in offering reservation and price information. The second becomes more severe when considering that it is the interactive features that differentiate for the specific dimension, between Cypriot and Greek hotel web sites. Cypriot hotels not only provide more reservation and price information but they provide it by using more interactive features. Jeong and Lambert (2001) reported that according to FIND/SVP (1997), fundamental purposes for web activities are information acquisition and transactions. While both Cypriot and Greek hotels manage to provide information to meet both these purposes, it seems that Cypriot hoteliers have made a step ahead in provide transactions tools to a greater degree while Greek hoteliers still provide general and contact information meaning their sites to serve more as electronic brochures. Still this difference can to some extend attributed to chain hotel effect in Cyprus. Taking this into account and also considering that high-class hotels and chain hotels in Greece are doing better in providing transactions information one could predict that this difference could diminish in the future starting from more informative and richer web sites of Greek chain and high class hotels.

Finally, the managerial characteristics of the hotels have a significant impact on the information provided through the web. While chain hotels and high-class hotels lead in providing information, they also seem to enhance the existing differences between countries. Particularly they do so for surrounding area information, management of the web site information, and company information.

TABLE 5: MULTIPLE REGRESSION MODELS FOR THE STUDY OF THE EFFECTS OF HOTEL CLASS AND CHAIN MEMBERSHIP

	Cyprus			**Greece**			**Both countries**		
Dependent variables/ Dimensions	Independ. variables	B	SE	Independ. variables	B	SE	Independ. variables	B	SE
	Constant			Constant			Constant	7.12	3.21
Facilities information	CLASS[a]	10.14	2.03	CLASS[a]	9.6	0.75	CLASS[a]	9.65	0.70
	CHAIN[b]			CHAIN[b]	9.8	1.56	CHAIN[b]	8.80	1.35
							COUNTRY[c]		
	Constant	51.75	2.78	Constant	50.2	0.56	Constant	47.04	1.10
Customer contact information	CLASS[a]			CLASS[a]			CLASS[a]		
	CHAIN[b]	-6.75	3.32	CHAIN[b]	2.1	0.98	CHAIN[b]		
							COUNTRY[c]	3.86	1.21
	Constant			Constant	5.4	2.55	Constant	4.48	2.48
Reservation prices information	CLASS[a]	4.94	1.86	CLASS[a]	2.1	0.56	CLASS[a]	2.39	0.54
	CHAIN[b]	6.90	3.04	CHAIN[b]	9.9	1.62	CHAIN[b]	9.83	1.04
							COUNTRY[c]		
	Constant	22.4	3.52	Constant	25.2	0.77	Constant	28.52	1.74
Surround. area information	CLASS[a]			CLASS[a]			CLASS[a]		
	CHAIN[b]	16.90	4.21	CHAIN[b]	6.23	1.35	CHAIN[b]	8.119	1.34
							COUNTRYc	-3.86	1.70
	Constant			Constant	14.99	1.91	Constant	12.83	1.84
Managem. of the web site	CLASS[a]			CLASS[a]	1.40	0.42	CLASS[a]	1.38	0.38
	CHAIN[b]	13.51	1.50	CHAIN[b]	8.09	0.87	CHAIN[b]	9.08	0.76
							COUNTRY[c]	1.91	0.93
	Constant	8.67	2.72	Constant	-13.23	3.63	Constant	-2.62	3.58
Company information	CLASS[a]			CLASS[a]	4.06	0.78	CLASS[a]	3.37	0.74
	CHAIN[b]	26.12	3.26	CHAIN[b]	18.84	1.65	CHAIN[b]	20.29	1.48
							COUNTRY[c]	-7.91	1.81
	Constant			Constant	-12.17	2.52	Constant	-11.49	2.35
Commun.	CLASS[a]	3.31	1.52	CLASS[a]	3.43	0.56	CLASS[a]	3.31	0.51
	CHAIN[b]	12.23	2.45	CHAIN[b]	12.23	1.15	CHAIN[b]	12.74	0.99
							COUNTRY[c]		

(a: CLASS, 1 'E', 2 'D', 3 'C', 4 'B', 5 'A', 6 'L')
(b: CHAIN, 0 'no chain member', 1 'chain member')
(c: COUNTRY, 0 'Cyprus', 1 'Greece')

REFERENCES

Apostolopoulos, Y. and Sonmez, S. (2000). New Direction in the Mediterranean Tourism: Restructuring and Cooperative Marketing in the Era of Globalization, *Thunderbird International Business Review*, Vol. 42, 381-392.

Baloglu, S., and Pekcan Y. (in press 2004). The web-design and Internet site marketing practices of upscale and luxury hotels in Turkey, *Tourism Management*, Articles in press.

Castleberry, J. and Hempell, C. (1998). Electronic shelf space on the global distribution network, *Hospitality and Leisure Executive Report* ,Vol. 5, 19-24.

Chen, K. and Yen, D.C. (2004). Improving the quality of online presence through interactivity, *Information & Management,* Vol. 42, 217-226.

Christou, E. (2003a). On-line buyer's trust in a brand and the relationship with brand loyalty: The case of virtual travel agents, *Tourism Today*, Vol. 3, 95-105.

Christou, E. (2003b). Guest loyalty likehood in relation to hotels' corporate image and reputation: a study of three countries in Europe, *Journal of Hospitality and Leisure Marketing*, Vol. 10, 85-99.

Christou, E. and Kassianidis, P. (2003). Consumer perception and adoption of online buying for travel products, *Journal of Travel and Tourism Marketing*, Vol. 12, 93-107.

Chung, T. and Law, R. (2003). Developing a performance indicator for hotel websites, *International Journal of Hospitality Management*, Vol. 22, 119-125.

Dieke, P. and Karamustafa, K. (2000). Cooperative Marketing in the Accommodation Subsector: Southeastern Mediterranean Perspectives, *Thunderbird International Business Review*, Vol. 42, 467-494.

Falzon, J. (2003). The competitive position of Mediterranean countries in tourism: evidence from the Thomson Brochure. *"Tourism Modelling and Competitiveness: Implications for Policy and Strategic Planning"*, http://www.erc.ucy.ac.cy/english/conference2003).

Froehle, C. and Roth A. (2004). New measurement scales for evaluating perceptions of the technology-mediated customer service experience, *Journal of Operational Management*, Vol. 22, 1-21.

Garces, S., Gorgemans, S., Sanchez, A. and Perez, M. (2004). Implications of the Internet – an analysis of the Aragonese hospitality industry, 2002, *Tourism management*, Vol. 25, 603-613.

Gratzer, M. and Winiwarter, W. (2003). The Role of the Internet in the SME Hotel sector in Austria, *Lecture notes in Computer Science*, Vol. 27, 85-95.

Hopkins, C., Raymond M. A. and Mitra, A. (2004). Consumer responses to perceived telepresence in the online advertising environment: The moderating role of involvement, *Marketing Theory*, Vol. 4 (1/2), 137-162.

Jupiter (2003). "Jupiter Research Forecast Report" (www.jup.com)

Morrison, M. A. Taylor, S. Morrison, J.A. and Morrison D. A. (1999). Marketing small hotels on the World Wide Web, *Information Technology and Tourism*, Vol. 2, 97-113.

Murphy, J., Forrest, E., Wotring, E. and Brymer, R. (1996). Hotel management and marketing on the Internet, *The Cornell Hotel and Restaurant administration Quarterly*, Vol. 37, 70-82.

O' Connor, P. and Frew, A. (2003). An evaluation methodology for Hotel electronic channels of distribution, *Hospitality Management*, Vol. 23, 179-199.

Pan, B. and Fesenmaier, D. (2000). A Typology of Tourism Related Web Sites: Its Theoretical Background and Implications. *In Information and Communication Technologies in Tourism*, Wien: Springer-Verlag, 381– 395.

Poon, A. (1994). The new tourism revolution, *Tourism Management*, Vol. 15, 91-99.

Rice, R.E. and Williams, F. (1984). Theories old and new: the study of new, in R.E. Rice (Ed.), *The New Media: Communication, Research and Technology*, Sage, Beverly Hills, CA, 1984, 55-80.

Scoviak, M. (2003). Maximize the Internet. Hotels, May 2003, 36-42.

Sigala, M. and Christou, E. (2002). *The transformative power of e-commerce on hotel brands*, In Proceedings of the Annual European Council for Hotel, Restaurant and Institutional Education (Euro-CHRIE) Conference, Cross-cultural Challenges in the Tourism Industry, Escola Universitarua St. Ignasi, Barcelona, Spain, 31 October-1 November, 2002.

Sigala, M. (2003a). Competing in the Virtual Marketspace: a strategic model for developing e-commerce in the hotel industry, *International Journal of Hospitality Information Technology*, Vol. 3, 43-60.

Sigala, M. (2003b). Developing and Benchmarking Internet Marketing Strategies in the Hotel Sector in Greece, *Journal of Hospitality and Tourism Research*, Vol. 27, 375-401.

Sigala, M. (2003c). *Investigating the e-factors impacting e-commerce adoption by Small and Medium Tourism Hospitality Enterprises (SMTHEs) in Greece: implications for sustainable development*, 2nd International Scientific Conference "Sustainable Tourism Development and Environment", Chios Island, Greece 2-5 October 2003.

Sigala, M. (2004a). *Customer relationship management (CRM) Evaluation: Diffusing CRM benefits into business processes*, 12th European Conference on Information Systems (ECIS) "The European IS Profession in the Global Networking Environment", Turku Finland 14-16 June, 2004.

Sigala, M. (in press 2004b). Integrating customer relationship management in hotel operations: managerial and operational implications, *Hospitality Management*, Articles in press.

Steuer, J. (1992). Defining Virtual Reality: Dimensions Determining Telepresence, *Journal of Communication*, Vol. 42, 73-93.

Vrana, V., Zafiropoulos, C. and Paschaloudis, D. (in press 2004). Measuring the Provision of Information Services in Tourist Hotel Web Sites : The Case of Athens-Olympic City 2004, *Tourism and Hospitality Planning & Development,* Vol. 1, No 3, 1-17.

Weeks, P. and Crouch, I. (1999). Sites for the sore eyes: an analysis of Australian tourism and hospitality web sites, *Information Technology and Tourism*, Vol. 2, 153-172.

Wei, S., Ruys, H., Van Hoof, H. and Combrink, T. (2001). Uses of the Internet in the global hotel industry, *Journal of Business Research*, Vol. 54, 235-241.

Zafiropoulos, C., Vrana, V. and Paschaloudis, D. (2004). *Patterns of Information services offered on the web, An analysis of Hotel-Company Practices*, Annual European Council for Hotel, Restaurant and Institutional Education (Euro-CHRIE) Conference "Global issues and trends in Hospitality and Tourism Industries", Ankara Turkey: Bilkent University, 3-7 November 2004.

The Cyprus Journal of Sciences, Vol. 3, 2005/249-276

PREDICTING FUTURE VOLATILITY WITH ATM IMPLIED VOLATILITY - A STUDY ON VX1, VDAX AND VIX

SOFIANE ABOURA*

ABSTRACT

It is well known that finding an accurate forecast of future volatility turns out to be very useful for pricing and hedging derivatives. The market's assessment of the underlying asset's volatility as reflected in the option price is known as the implied volatility of the option. Based on relevant papers written on the forecasting ability of implied volatility, this article deals with the accuracy of international volatility indexes (VX1, VDAX and VIX). This is the first paper that copes with international volatility indexes. We find that VX1, VIX and VDAX are better tools than historical volatility for predicting future realized volatility.

Keywords: GARCH model, implied volatility index, risk management

1. INTRODUCTION

1.1. The volatility in the heart of option theory

Central to the ongoing development of practical financial risk management methods is recognition of the fact that asset return volatility is often forecastable. Nevertheless, volatility is a crucial piece in the measurement of VaR.

Mandelbrot (1963) and Fama (1965) have produced some work on the distributional characteristics of speculative returns. Many of early papers found that daily returns were serially uncorrelated, a conclusion that is still debated in finance. However, there is today a large consensus on the fact that daily and monthly returns are approximately unpredictable, while returns

* Professor of Finance, Paris Graduate School of Management, France

volatility is highly predictable and this is the reason why we devote this paper to the forecast of future returns volatility. Various tools for estimating the variance have been developed in the past twenty five years.

Indeed, the parametric models, such as the ARCH models set up by Engle (1982) and then extended by various researchers have been devoted to the volatile behavior of stock returns time series. The conditional variance is set as a linear equation depending on past observed conditional variances and past squared shocks in the returns process. The beauty of this processes is that the variance is simply observable, which is not the case with continuous time models. These econometric models proved their usefulness in option theory since Duan (1995) proposed a numerical model based on NGARCH specification to price options.

The development of stochastic volatility models has been essential in the modeling of time-varying volatility. Hull and White (1987), Scott (1987), Wiggins (1987) were the first to adopt bivariate diffusion in pricing options. However, their models provide numerical solutions in contrast with the Hull and White (1988) and the Heston (1993) models where the correlation paramter between asset returns and their volatility can be different from zero.

Besides, the recognition that asset returns are leptokurtic, especially for short periods, incited Merton (1976) to price options through jump-diffusion processes. Other researchers like Bates (1996) included a jump parameter in a context of a stochastic volatility model.

1.2. The debate on the predictive power of implied volatility

The implied volatility of the option is known to be the market's assessment of the underlying asset's volatility as reflected in the option price. Implied volatility has been generally calculated through the Cox-Ross-Rubinstein (1979) binomial model or through the Black-Scholes (1973) formula but more sophisticated option pricing formula can be used to calculate implied volatilities. We usually use implied volatility as being a forecast tool of the future returns volatility over the remaining life of the relevant option. Now, if we consider the market as being efficient, we should consider in the same way implied volatility as being an efficient forecast of future volatility. In fact, one

of the basic aspects of the option pricing theory states that option prices should have a positive correlation with the underlying asset's volatility, that is to say that implied volatility and future realized volatility should be correlated. This means that we can through implied volatility predict future realized volatility. However, the use of implied volatility as a forecast of future volatility has been the object of various articles. Indeed, many papers concerning the implied volatility predictive power have been written and those articles came to opposite conclusions.

On one hand, Canina and Figlewsky (1993) claimed that implied volatility has no explanatory power. They didn't find any correlation between implied volatility and future returns volatility. Day and Lewis (1992) who studied the relative forecasting power of implied volatility versus historical data through the S&P 100 index options, with date expirations from 1985 to 1989, came to the conclusion that implied volatility is both biased and inefficient. Day and Lewis (1992) assessed the information content and the predictive power of time series volatilities like GARCH and EGARCH from 1983 to 1989. The forecasting horizon considered was one week ahead while Lamoureux and Lastrapes (1993) examine one day-ahead predictive power of implied volatility. Lamoureux and Lastrapes (1993) focused on options written on ten stocks from 1982 to 1984 using the Hull and White (1987) stochastic volatility option pricing model. They found that historical time series contains predictive information about future volatility beyond that contained in implied volatility.

On the other hand, Latané and Rendleman (1976), Chiras and Manaster (1978), Beckers (1981) found that stocks with high implied volatilities also have high ex-post realized volatilities. We must, however, note that these studies were carried out after the beginning of the CBOE in 1973 and thus, were limited by a short time span; this is why their perspective was limited to a cross-sectional view. Later on, some researchers proposed results based on the family of conditional heteroscedastic processes. Scott and Tucker (1989) measured the implied standard deviation from PHLX currency options from 1983 to 1987. They reported some predictive ability in implied volatility; however, Jorion (1995) said that their methodology doesn't allow formal test of hypotheses. Jorion (1995) found that implied volatility is an efficient indicator of future return volatility for foreign currency futures. Fleming (1993) concluded that implied volatility is an upwardly biased estimator of future

volatility even if the magnitude of the bias is not economically significant. He also concluded that implied volatility dominates past volatility as a forecast of future volatility. Sheikh (1993) examined the time series of implied volatilities and its relationship to returns in the underlying stock. He found positive autocorrelation in the time series of implied volatilities and a positive relationship between returns and lagged implied volatility. We can explain a part of these contradictory conclusions through the analysis of the method used in these studies:

For instance, Day and Lewis (1992) sampled the implied volatility at a weekend frequency while Lamoureux and Lastrapes (1993) used a daily frequency. The choice of these strong frequencies generates overlapping data according to Christensen and Prabhala (1998). They opposed to Lamoureux and Lastrappes (1993) and to Day and Lewis (1992) their use of overlapping data which biased their conclusions concerning the inefficiency of implied volatility. They criticized the methods used in former studies, which found that implied volatility has virtually no correlation with future returns volatility such as Canina and Figlewski (1993). As a response they proposed a different sampling methodology using (monthly) nonoverlapping data and an instrumental variables framework to correct the error-in-variable problems in OEX implied volatility. They proposed to use monthly implied and realized volatility series. More generally, we can see that some of the bad estimation of volatility can be due to measurement errors or to misfit statistical deductions:

Measurement errors in option volatility can be due to a certain number of stale quotes that affect the S&P 100 Index. In addition, high transaction costs may permit market prices to diverge significantly from theoretical prices. Many studies are based on the OEX index options or on individual stock options for which the transaction costs are non negligible. This is why some authors prefer to study implied volatility in a liquid market with low transaction costs.

In the same way, the bias observed in implied volatility computed from the Black-Scholes model can be, for a certain part, attributed to the huge transaction costs linked with the hedging of options in the cash index market. Nevertheless, Constantinides (1994) reported that transaction costs do not have a first-order effect on option prices. In other words, we can affirm that

transaction costs don't explain, by themselves, the observed spread between the Black-Scholes (1973) formula and effective OEX option prices.

Another problem is the fact that most of the option models hinge on the volatility parameter and therefore the misspecification of the volatility due to the lack of the information content questions seriously the validity of these models which can be therefore, source of biases. Nevertheless, there are relatively few studies that used sophisticated option models consistent with stochastic volatility. The main reason seems that it can be shown (Feinstein (1992)) for a stochastic volatility model that the value of an at-the-money option is approximately equal to the Black-Scholes (1973) value with the volatility equal to the average expected volatility of the underlying stock over the remaining lifetime of the option; in other words, Black-Scholes (1973) model yields estimates almost identical to those of a stochastic volatility model for an ATM option. Moreover, as Jorion (1995) said, the stochastic volatility models involve costly numerical simulations and they assume a specific time-series process for the volatility, which can be source of error since they require the estimation of additional structural parameters.

This paper is organized as follows: Section 2 provides descriptive statistics. Section 3 displays the analysis of the role of the volatility indexes in the prediction of future realized volatility. Section 4 concludes.

2. DESCRIPTIVE STATISTICS

The sample spans a time period of five years with 1418 daily observations beginning from March, 31st 1994 to January, 31st 1999. The CAC40 data, the DAX30 data and the S&P100 are extracted from DATASTREAM.

TABLE 1: STATISTICAL PROPERTIES OF DAILY CAC40, DAX30 AND S&P100 INDEX RETURNS

Statistics	Results		
	CAC40	DAX30	S&P100
Mean	0.074088	0.075651	0.093522
Standard Deviation	1.259086	1.319549	0.996384
Skewness	-0.064483	-0.451446	-0.471508
Kurtosis	4.927113	6.663845	8.475704
Autocorrelation $\rho(r_t, r_{t-1})$	0.036	0.009	-0.006
Autocorrelation $\rho(r_t, r_{t-2})$	-0.021	-0.065**	-0.005
Autocorrelation $\rho(r_t, r_{t-3})$	-0.022	0.024*	-0.060
Ljung-Box - Q(12)	17.933	16.132	23.952**
Autocorrelation $\rho(r_t^2, r_{t-1}^2)$	0.170***	0.241***	0.261***
Autocorrelation $\rho(r_t^2, r_{t-2}^2)$	0.177***	0.242***	0.145***
Autocorrelation $\rho(r_t^2, r_{t-3}^2)$	0.136***	0.170***	0.068***
Ljung-Box - Q(12)	294.28***	510.66***	250.66***
Jarque Bera	220.4044***	841.2858***	1824.057***
ARCH(1) LM TEST	49.95058***	91.25966***	98.52001***

*** Significantly different from zero at the 1 % level, ** at the 5% level and * at the 10% level.

The empirical analysis of the CAC 40, DAX30 and S&P100 Index returns are summarized in Table 1. For the CAC40 index, the mean over the entire sample period is 0.074. The standard deviation is 1.259. We note that this series is slightly skewed and leptokurtic. Skewness and Kurtosis are combined to test if the distribution is normal with the Jarque-Bera (1980) test. The test indicates that normality can be rejected for all indices even if we see that for the CAC40 returns, Jarque-Bera test is the lowest.

Table 1 also provides the auto-correlation structure from one through three lags. None of them is significant. We also display the Ljung-Box (1979) statistic for twelve lags to document the presence of any linear dependence in returns. The Ljung-Box Q statistic tests for serial correlation by summarizing the auto-correlations. Even up to 12 lags there is no linear dependence for the

CAC40 index returns. The Jarque-Bera test indicates that the normality assumption can be rejected for the DAX30 and the S&P100 index returns. We note the strong linear dependence between second moments. The ARCH LM test confirms the presence of conditional heteroskedasticity. According to Merton (1980), a simple way to approximate the instantaneous volatility is to take the squared or absolute value of returns. It helps to detect if there is some non-linear or quadratic dependence in returns to look for some patterns in the conditional volatility. We can notice the strong linear dependence between second moments at the first, second and third order auto-correlation. The Ljung-Box Q-statistics at 12 lags are all statistically significant for all stock market indices. It is usually interpreted as a presence of ARCH-type effects in the conditional volatility. We also carry out the ARCH test for one lag distributed as a chi-square with one degree of freedom. The ARCH LM procedure tests for autoregressive conditional heteroskedasticity. We get significant results for the three stock market indices and this confirms the presence of conditional heteroskedasticity.

TABLE 2: STATISTICAL PROPERTIES OF DAILY MARKET VOLATILITY INDEX CHANGES

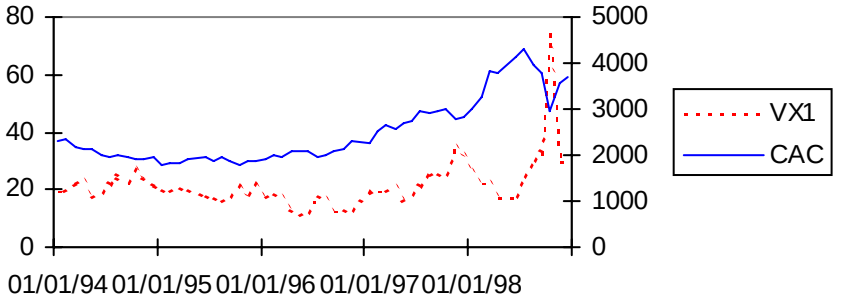
Statistics	Results		
	$\Delta VX1$	$\Delta VDAX$	ΔVIX
Mean	0.002462	0.006114	0.006679
Standard Deviation	3.514430	1.508738	1.446914
Skewness	0.945658	0.693295	1.079302
Kurtosis	27.28575	13.78398	12.28274
Autocorrelation (ρ =1)	-0.295***	-0.111***	-0.138***
Autocorrelation (ρ =2)	-0.185***	-0.054***	-0.053***
Autocorrelation (ρ =3)	0.049***	-0.014***	-0.076***
Ljung-Box - Q(12)	305.25***	49.433***	81.373***
Cross Correlations (t =-1)	0.1660	0.0250	0.1207
Cross Correlations (t =0)	-0.4592	-0.5607	-0.7891
Cross Correlations (t =1)	-0.0469	-0.0199	0.0151
Jarque Bera	35058.55***	6984.641***	5366.468***

*** Significantly different from zero at the 1 % level, ** at the 5% level and * at the 10% level.

Following Fleming-Ostdiek-Whaley (1995), the empirical analysis of the volatility indices is done on volatility changes. Table 2 summarizes the properties of daily VX1, VDAX and VIX first difference denoted respectively $\Delta VX1, \Delta VDAX, \Delta VIX$. Data are extracted from DATASTREAM. The mean of $\Delta VX1$ is 0.002462. The standard deviation is 3.514430. We note that $VX1$ is relatively skewed but highly leptokurtic in comparison with the CAC40 index. Table 2 also provides the auto-correlation structure of the volatility indexes from one through three lags. The first and second order coefficients, respectively -0.295 and -0.185, reveal a significant negative auto-correlation for the $\Delta VX1$. Table 2 displays the cross-correlation between the volatility first differences and the index returns. Correlation for negative (positive) lags denotes the correlation between volatility changes and past (future) index returns. We see that the correlation between the contemporaneous CAC40 index returns and the $\Delta VX1$ is negative.

Figure 1 displays the reverse relation between implied volatility and index returns. Black (1992) explains that the inverse relationship between stock prices and volatility can be for a part attributable to changes in operating leverage. When stock prices decrease, leverage increases; it causes an increase in expected volatility; i.e., in the implied volatility.

FIGURE 1: THE EVOLUTION OF VX1 AND CAC 40



In the next section, we study the information content and the predictive power of the three implied volatility indexes. By looking the predictive power, we want to know what can be concluded about the next period's realized volatility knowing the current volatility. Working on the information content is

a manner to understand if implied volatility contains additional information relative to historical volatility.

3. THE PREVISION OF THE FUTURE REALIZED VOLATILITY

We assess the information content and predictive power of the volatility indexes to compare it to past realized volatility and GARCH (1,1) volatility. Then, we discuss the problem of the computation of a long-term volatility.

3.1. The methodology

Christensen and Prabhala (1998) proposed to use Instrumental Variable Procedure as a way of correcting Error-in-Variable problems in OEX implied volatility. They assumed that EIV problem causes implied volatility to appear both biased and inefficient. We use this framework in our study.

The realized volatility is the volatility observed of the underlying asset. The underlying asset considered here is the CAC 40 French index. The realized volatility is the volatility computed as a 22-day-window, which represents the number of trading days. Past realized volatility represents the volatility of the underlying over the last 22 days. Future realized volatility represents the volatility of the underlying over the next 22 days. Let $\sigma_t(\tau)$ be the realized volatility over the remaining contract life, measured from day t to day $t+\tau$ ($\tau = 1\ \text{month}$), defined as:

$$\sigma_t^2(\tau) = \frac{1}{2}\left(\frac{\Gamma\left(\frac{\tau-1}{2}\right)}{\Gamma\left(\frac{\tau}{2}\right)}\right)^2 \sum_{i=1}^{\tau}\left(r_{t+i} - \bar{r}\right)^2$$

where r_t is the return at t and $\bar{r}$ is the sample mean of r_t.

The underlying asset considered for the VDAX is the DAX30 index. The realized volatility is the volatility computed as a 33-day-window, which represents the number of trading days. Past realized volatility represents the volatility of the underlying over the last 33 days. Future realized volatility represents the volatility of the underlying over the next 33 days. The underlying asset considered for the VIX is the S&P100 index. The US realized volatility is constructed just like the French index with a 22-day window.

3.2. The analysis of the information content and predictive power

3.2.1. Forecasting the future realized volatility: a first approach

In this section we show that implied volatility contains incremental information beyond that of historical volatility. Early studies (see Jorion (1995), Canina-Figlweski (1993), Fleming-Ostdiek-Whaley (1995), Adjaoute and Bruand and Gibson (1998), Christensen and Prabhala (1998) for exemple) of the information content in option prices focused on volatility. While Jorion (1995) and Fleming-Ostdiek-Whaley (1995) found that implied volatilities contained substantial information for future volatility, Canina and Figlewski (1993), reported that implied volatilities had little predictive power for future volatility and therefore they were significantly biased forecasts. The predictive power of a volatility forecast can be estimated by regressing the realized volatility on the volatility forecast through these three equations:

$$\sigma_t(\tau) = a + b\sigma_t^{IMP} + \varepsilon_t \qquad (1)$$

$$\sigma_t(\tau) = a + c\sigma_{t-\tau}^{HIST} + \varepsilon_t \qquad (2)$$

$$\sigma_t(\tau) = a + b\sigma_t^{IMP} + c\sigma_{t-\tau}^{HIST} + \varepsilon_t \qquad (3)$$

The volatility forecast measured on day *t*, can either be the implied volatility index denoted σ_t^{IMP} or the historical volatility denoted $\sigma_{t-\tau}^{HIST}$. In this case, we would expect the intercept to be zero and the slope coefficient to be unity. Canina-Figlewski (1993) suggested that an AR (1) specification using the historical rate dominates the OEX implied volatility as a forecast of realized volatility. As pointed out by Jorion (1995) and Canina-Figlewski (1993), with horizons of up to one month, however, using daily data might introduce overlaps in the error terms, which causes a downward bias in the usual Ordinary Least Squares (OLS) standard errors. While White's (1980) covariance matrix presumes that the residuals to the estimated equation are serially uncorrelated, Newey-West (1987) has proposed an alternative that gives consistent estimates of the covariance matrix in the presence of both heteroskedasticity and auto-correlation. The Durbin-Watson statistic is a formal test for serial correlation. The Durbin-Watson statistic is a measure of first-order auto-correlation. They measure the association between adjacent residuals. If there is no problem of association between adjacent residuals, the

statistic will be around 2. For a positive serial correlation, the Durbin-Watson will drop below 2; otherwise, in the worst cases, it will be near zero. Positive serial correlation implied that the reliability of the reported regression results is probably overstated. Occasionally, negative serial correlation will take place and the Durbin-Watson statistic will lie somewhere between 2 and 4.

We can test 3 hypotheses on equation (1). If implied volatility contains information about future volatility we should get b different from zero. If implied volatility is an unbiased forecast of realized volatility we should get $a=0$ and $b=1$. If implied volatility is efficient, ε_t should be white noise and uncorrelated.

Taken alone, VX1, VIX and VDAX have a relatively high information content since the estimate of b is statistically significant, 0.723, 0.901 and 0.712 even if it is not equal to one. Since a is not equal to zero and b is not equal to one, we say, in accordance with Jorion (1995), that implied volatility appears to be a biased predictor of future realized volatility. However, implied volatility remains a better predictor than past realized volatility. Indeed, taken alone, historical volatility of the French index, the US index and the German index is statistically significant (respectively 0.628, 0.634 and 0.560) but its information content is quite inferior to the implied volatility predictive power. If we put in the same regression implied volatility and past volatility, we obtain interesting results. Indeed, we notice that if implied volatility gains slightly of its predictive power, growing from 0.712 to 0.791 for the VIX and from 0.901 to 1.360 for the VDAX, past volatility decreases strongly from 0.560 to -0.087 for the S&P100 and from 0.634 to -0.464 for the German index. As for the VX1, it loses some of its predictive power when put together with past volatility, dropping from 0.723 to 0.629 while past volatility collapses, dropping from 0.628 to 0.118. We see that the slope coefficient for implied volatility remains statistically significant in the multivariate regression. On the other hand, the estimate of past volatility of the French and the US market is not significant when past volatility is added as an explanatory variable, which suggests that implied volatility is not that inefficient. Christensen and Prabhala (1998) obtained an estimate of implied volatility taken alone of 0.76 and an estimate of past volatility taken alone of 0.57; put together, they found an estimate of implied volatility of 0.56 and a significant estimate of past volatility of 0.23. These results are in deep contrast to those reported by Canina

and Figlewski (1993) who report slope coefficient of 0.229 on implied volatility. We globally found the VIX less better adjusted R-squared than Christensen and Prabhala (1998), but our Durbin-Watson statistic is not significantly different from two, indicating that the residuals are not autocorrelated.

TABLE 3: PREDICTABILITY REGRESSIONS

$$\sigma_t(\tau) = a + b\sigma_t^{IMP} + \varepsilon_t \quad (1)$$

$$\sigma_t(\tau) = a + c\sigma_{t-\tau}^{HIST} + \varepsilon_t \quad (2)$$

$$\sigma_t(\tau) = a + b\sigma_t^{IMP} + c\sigma_{t-\tau}^{HIST} + \varepsilon_t \quad (3)$$

	VX1 - Slopes on		
Intercept	Implied	Historical	Adj.R²
0.002523*	0.723296*		0.504649
(3.094982)	(10.32133)		
0.004523*		0.628488*	0.372421
(3.734723)		(5.580595)	
0.002349*	0.629409*	0.118463	0.508945
(2.599834)	(7.487052)	(1.224343)	
	VDAX - Slopes on		
Intercept	Implied	Historical	Adj. R²
0.001139	0.900608*		0.578697
(1.305935)	(10.80275)		
0.004651*		0.634024*	0.351874
(5.782839)		(8.08454)	
0.000973	1.360137*	-0.463645*	0.616103
(1.236513)	(8.437087)	(-3.485339)	
	VIX - Slopes on		
Intercept	Implied	Historical	Adj. R²
0.00027	0.71185*		0.457485
(0.29879)	(7.887479)		
0.00378*		0.560361*	0.312184
(6.845693)		(7.35083)	
9.37E-05	0.791212*	-0.08788	0.458993
(0.092198)	(5.081064)	(-0.904463)	

*Significantly different from zero at the 5 percent level.
Numbers in parentheses denote asymptotic t-statistics.

3.2.2. The instrumental variable approach

The main goal is to use equations (5) and (4) within an instrumental variable framework in order to correct EIV problems that occur in the OEX implied volatility. But, we also want to check if past volatility is a good predictor of implied volatility. Since past volatility is related to future volatility and since implied volatility reflects future volatility information, we should have an implied volatility that depends on past volatility. Let's focus on an alternative specification such as:

$$\sigma_t^{IMP}(\tau) = \alpha + \beta\sigma_{t-1}^{IMP} + \varepsilon_t \qquad (4)$$

$$\sigma_t^{IMP}(\tau) = \alpha + \beta\sigma_{t-1}^{IMP} + \gamma\sigma_{t-\tau}^{HIST} + \varepsilon_t \qquad (5)$$

EIV problems are characterized in Table 3 with the use of the classical OLS estimators. As Christensen and Prabhala (1998), we established that EIV problem explains why implied volatility is both biased and inefficient. As recalled by them, Greene (1993) in his chapter 9 gives results based on standard least squares asymptotics. If we suppose that implied volatility is $\sigma_t^{IMP} = \sigma_t^{IMP*} + \eta_t$, with σ_t^{IMP*} denoting the true implied volatility and η_t denoting the measurement error (not correlated with σ_t^{IMP*}). We have then the probability limit of the OLS estimated of b in equation (1) is given by:

$$b_u^* = b\frac{1}{1+(\sigma_\eta^2 / \sigma^{IMP*2})} \qquad (6)$$

The limits of the OLS estimated of slope coefficients b and c in equation (3) are given by:

$$b_m^* = b\frac{1-\rho^2}{1-\rho^2+(\sigma_\eta^2 / \sigma^{IMP*2})} \qquad (7a)$$

$$c^* = c + b^*\frac{\sigma_\eta^2}{\sigma^{IMP*}\sigma^{HIST}}\frac{\rho^2}{1-\rho^2} \qquad (7b)$$

with σ^{IMP*2}, σ^{HIST2}, σ_η^2 and ρ are respectively the variance of true implied volatility, past realized volatility, the measurement error and the correlation between true implied volatility and past realized volatility.

Some of these measurement errors due to the American nature of OEX options, do concern as well the PX1 options and therefore the VX1 index. Indeed, Christensen and Prabhala (1998) calculated implied volatility, knowing that the option model considered, applies to the European style call option based on an underlying asset that is known to pay dividends before the expiration time. Now, OEX options are of American style and their underlying asset, the S&P100 index, pays dividends. Thus, the fact that dividends reduce call values, this means that the implied volatility extracted from the Black-Scholes (1973) formula will underestimate the implied volatility real value.

Christensen and Prabhala (1998) recalled that in the Black-Scholes formula index levels are supposed to follow a lognormal diffusion process including a deterministic volatility. They noted, on what Heston (1993) said about the misspecification of the Black-Scholes (1973) formula, that using an implied volatility as a forecast will amplify the Error-in-Variable problem. Now, the EIV problem has a double effect. The first one is to generate a downward bias for the slope coefficient of implied volatility and the second one is an upward bias for the slope coefficient of past volatility, in the condition that b and ρ are positive as it empirically. This explains the underestimation of implied volatility and the over estimation of past volatility. This discussion suggests that the usual OLS will lead to false conclusions concerning OEX implied volatility predictive power. Efficient estimation is possible under an Instrumental Variable procedure.

Globally, the implied volatility is first regressed on an instrument and fitted values from this regression replace implied volatility in equations (1) and (3). These specifications are then estimated by the OLS procedure. Actually, under this procedure, implied volatility σ_t^{IMP} is first regressed on an instrument and following Christensen and Prabhala (1998), we choose σ_{t-1}^{IMP} as a natural candidate for instrument. With σ_{t-1}^{IMP} as the instrument, Instrumental Variable estimation of specification (1) is done by replacing implied volatility, σ_t^{IMP} by fitted values from the regression σ_t^{IMP} on σ_{t-1}^{IMP} and we finally use OLS to estimate equation (1). Then, we regress this time σ_t^{IMP} on both σ_{t-1}^{IMP} and $\sigma_{t-\tau}^{HIST}$ for the specification (3). Table 4 reports estimates based on this

Instrumental Variable Procedure.

We note that regressing σ_t^{IMP} on σ_{t-1}^{IMP} and on $\sigma_{t-\tau}^{HIST}$ can also be used in estimating equation (1); in this situation, the procedure is equivalent to estimating equation (1) with two instruments (i.e. σ_{t-1}^{IMP} and $\sigma_{t-\tau}^{HIST}$) for implied volatility instead of only one (i.e. σ_{t-1}^{IMP}). According to Christensen and Prabhala (1998), both approaches give empirically similar results.

Section 1 of Table 4 reports estimates of the first stage regression of specifications (4) and (5). Section 2 reports IV estimates of specifications (1) and (3). If we replace the right-hand if equation (5) for σ_t^{IMP} into equation (3), we get:

$$\sigma_t(\tau) = x + y\sigma_{t-1}^{IMP} + z\sigma_{t-\tau}^{HIST} + \varepsilon_t \qquad (8)$$

with $z = c + b\gamma$ and $y = b\beta$. By solving these equations, we get:

$$c = z - \gamma\frac{y}{\beta} \qquad (9a)$$

$$b = \frac{y}{\beta} \qquad (9b)$$

The estimates of equation (8) are not reported in Table 4. The estimates of equation (8) for the VDAX are y=1.329488 and z=-0.441817 (y and z are statistically significant at 5%) and we see (Section 1 – Table 4) that for the VDAX, β=0.966106 and γ=0.025221. If we replace these values in the equation (9a), we get c=-0.476524381, which is the same as the corresponding IV estimate (see Section 2 – Table 4) and which is slightly smaller than the OLS estimate obtained in Table 3, i.e., -0.463645. In the same manner, in replacing the same values in equation (10b), we get b=1.3761313057, which is the same as the IV estimate and which is slightly higher than the OLS estimate, i.e., 1.360137.

In comparison, Christensen and Prabhala (1998) found an estimate of implied volatility of 1.04; and -0.06 for the past volatility. As for the Durbin-Waston statistics, they are all significantly different from two, meaning that the residuals are auto-correlated. For VX1, the use of the IV procedure showed that under the OLS procedure, the implied volatility was underestimated and

the past volatility was overestimated. Nevertheless, the IV procedure applied for the VIX and VDAX didn't change significantly the estimate of both implied volatility and past realized volatility.

TABLE 4: SECTION 1: FIRST STAGE REGRESSION ESTIMATES

$$\sigma_t^{IMP}(\tau) = \alpha + \beta\sigma_{t-1}^{IMP} + \varepsilon_t \quad (4)$$

$$\sigma_t^{IMP}(\tau) = \alpha + \beta\sigma_{t-1}^{IMP} + \gamma\sigma_{t-\tau}^{HIST} + \varepsilon_t \quad (5)$$

	VX1 - Slopes on		
Intercept	Implied	Historical	Adj.R^2
0.001224*	0.905963*		0.820009
(4.793943)	(44.42665)		
0.00096*	0.747687*	0.197215*	0.832873
(3.30461)	(17.93607)	(3.850632)	
	VDAX - Slopes on		
0.000117	0.991283*		0.978304
(1.770068)	(155.7421)		
0.000128	0.966106*	0.025221	0.978434
(1.841736)	(72.43091)	(1.802437)	
	VIX - Slopes on		
0.00028*	0.976503*		0.953063
(2.857112)	(103.6017)		
0.000404*	0.922029*	0.059925*	0.954017
(3.731617)	(53.22028)	(3.298601)	

SECTION 2: SECOND STAGE INSTRUMENTAL VARIABLE ESTIMATES

$$\sigma_t(\tau) = a + b\sigma_t^{IMP} + \varepsilon_t \qquad (1)$$

$$\sigma_t(\tau) = a + b\sigma_t^{IMP} + c\sigma_{t-\tau}^{HIST} + \varepsilon_t \qquad (3)$$

	VX1 - Slopes on		
Intercept	Implied	Historical	Adj. R^2
0.001813	0.777915*		0.501839
(1.956911)	(9.829219)		
0.001815	0.783499*	-0.006303	0.500801
(1.953124)	(6.463367)	(-0.058261)	
	VDAX - Slopes on		
Intercept	Implied	Historical	Adj. R^2
0.001191	0.896259*		0.578674
(1.350263)	(10.6575)		
0.000928	1.376131*	-0.476525*	0.616064
(1.152206)	(8.156188)	(-3.459802)	
	VIX – Slopes on		
Intercept	Implied	Historical	Adj. R^2
0.000342	0.705571*		0.457275
(0.373514)	(7.722572)		
0.000169	0.775098*	-0.074688*	0.458763
(0.156617)	(4.571672)	(-0.696114)	

*Significantly different from zero at the 5 percent level.
Numbers in parentheses denote asymptotic t-statistics.

3.2.3. Implied volatility embedded in a GARCH equation

An important way of modeling the evolution of the conditional variance of stock is the estimation based on ARCH family models. These models capture the persistence in the conditional variance. The simple GARCH (1,1) model establishes that the variance of returns follows a predictable process, driven by the last squared innovation and by the previous conditional variance:

$$R_t = \mu + \varepsilon_t$$
$$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}$$
$$\varepsilon_t \sim N(0, h_t)$$

Where R_t is the nominal return and ht is the conditional variance taken as the realized variance of day *t*. We impose the usual regularity and covariance stationarity conditions, $0<\omega<\infty$, $\alpha\geq 0$, $\beta\geq 0$, and the sum of $(\alpha+\beta)$ must be less than unity, which enables us to make volatility forecasts over any horizon.

TABLE 5: ESTIMATION OF GARCH (1, 1) PROCESS

$$R_t = \mu + \varepsilon_t \qquad \varepsilon_t \sim N(0, h_t)$$
$$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}$$

	μ	ω	α	β	Log-Likelihood
VX1	0.000559	8.54E-07	0.050399*	0.946589*	3325.169
	(1.67306)	(1.134892)	(5.027198)	(75.96209)	
VDAX	0.000921*	4.25E-06*	0.120631*	0.854987*	3382.099
	(3.089613)	(3.659514)	(6.583032)	(37.09575)	
VIX	0.000992*	1.13E-06*	0.09652*	0.896358*	3710.474
	(4.384254)	(3.162643)	(9.833588)	(71.37514)	

*Significantly different from zero at the 5 percent level.
Numbers in parentheses denote asymptotic t-statistics.

We can go further in the analysis of the different and the best ways of modelling and thus predicting future realized volatility. The GARCH model offers a natural benchmark for evaluating the information content of the implied volatility. The usual form is:

$$h_t = h_t^{GARCH} + \delta v_t^{IMP} \text{ where } v = \sigma^2 \qquad (10)$$

Day and Lewis (1992) and Lamoureux and Lastrapes (1993) were the first who included the implied volatility in a GARCH equation such as:

TABLE 6: ESTIMATION OF GARCH (1, 1) PROCESS INCLUDING AN IMPLIED VOLATILITY

$$h_t = h_t^{GARCH} + \delta v_t^{IMP}$$

	ω	α	β	δ	Log-Likelihood
VX1	6.09E-06	0.00617	0.253258	0.571345*	3350.105
	(0.734429)	(0.275026)	(1.614861)	(4.644427)	
VDAX	-9.44E-06	0.02685*	-0.774383*	1.618856*	3437.141
	(-1.034498)	(3.180475)	(-11.22776)	(15.18126)	
VIX	-8.30E-06*	0.041253*	-0.565691*	0.828723*	3782.225
	(-2.029112)	(3.699405)	(-4.535242)	(11.15102)	

*Significantly different from zero at the 5 percent level.
Numbers in parentheses denote asymptotic t-statistics.

The estimate for implied volatility is higher than the estimate for past volatility whatever the index. This means that the information content of implied volatility is superior to the information content of past volatility.

3.2.4. Temporal Aggregation of a GARCH (1, 1) model

Usually, we study a situation where the object of interest is the average volatility over an interval, as is it the case for option pricing purpose. The object of interest in risk management, however, is different; it is the volatility of the end-of-period portfolio value. We all know that short-horizon asset returns volatility fluctuates and is highly forecastable. But much less is known about the forecastability of long-horizon volatility and about the speed and pattern with which forecastability decreases as the horizon lengthens. This problematic is being clearly very much at the center of modern risk management preoccupation. But what is the relevant horizon for risk management? This obvious question has no obvious answer. There is a little doubt that volatility is forecastable on a very high frequency basis, such as hourly or daily (see for example Andersen and Bollerslev (1997)). However, few things are known about volatility forecastability at longer horizons, and more generally, the pattern and speed of decay in volatility forecastability as we move from short to long horizons. In fact, the question that comes to our minds is to see whether long-horizon volatility is forecastable enough for

volatility models to remains useful for long-horizon risk management.

Generally, if we want to evaluate long-horizon volatility forecastability, we must consider two ways of converting short-horizon volatility into long-horizon volatility. We can either use scaling or formal based aggregation. We usually convert 1-day horizon to *n*-day horizon in order to assess risk. This conversion is done through the multiplication of the 1-day horizon by the square root of *h*-day horizon. To obtain a one-year horizon, we would multiply a 1-day volatility by $\sqrt{252}$. But Christoffersen, Diebold and Schuermann (1998) showed that scaling is inappropriate and misleading in non *iid* Environments. Thus, as shown by Diebold, Hickman Inoue, and Schuermann (1998), scaling is misleading and tends to produce spurious magnification of volatility fluctuations with horizon. In fact, they pointed out that a more appropriate temporal aggregation strategy is to fit a model to the high-frequency data and, conditional upon the truth of the fitted model, use it to infer the properties of the low-frequency data.

Drost and Nijman (1993), for example, provide temporal aggregation formula for the GARCH (1, 1) process. We also refer to the excellent work of Diebold, Hicman, Inoue and Schuermann (1998), Christoffersen, Diebold and Schuermann (1998).

Let S_t be a log price at time t and we assume that the log price is independently and identically distributed. We have $\ln S_t = \ln S_{t-1} + \varepsilon_t$. Then we have the 1-day return $R_t = \varepsilon_t$ where $\varepsilon_t \sim iid(0,\sigma^2)$ with σ the standard deviation. In the same way we have $\ln S_t / S_{t-n} = \sum_{i=0}^{n-1} \varepsilon_{t-i}$ with variance $n\sigma^2$ and standard deviation $\sqrt{n}\sigma$. Now if 1-day returns are *iid*, but high-frequency financial asset returns are distinctly not *iid* .

High frequency portfolio returns are conditional-mean independent but they are not conditional-variance independent as many papers have shown strong volatility persistence in financial asset returns. Drost and Nijman (1993) studied the temporal aggregation of GARCH processes. They began with a one-day return series $R_{(1)t}, t = 1, \cdots, T$ which follows the GARCH (1,1) process.

Then Drost and Nijman (1993) showed that under regularity conditions the corresponding sample path of *h*-day returns $R_{(n)t}, t = 1, \cdots, T/n$ similarly follows a GARCH (11) process with:

$$h_{(n)t} = \omega_{(n)} + \beta_{(n)} h_{(n)t-1} + \alpha_{(n)} \varepsilon^2_{(n)t-1}$$

where

$$\omega_{(n)} = n\omega \frac{1-(\alpha+\beta)^n}{1-(\alpha+\beta)}$$

$$\alpha_{(n)} = (\alpha+\beta)^n - \beta_{(n)}$$

and

$$\frac{\beta_{(n)}}{1+\beta^2_{(n)}} = \frac{a(\alpha+\beta)^n - b}{a(1+(\alpha+\beta)^{2n}) - 2b}$$

where

$$a = n(1-\beta)^2 + 2n(n-1)\frac{(1-\beta-\alpha)^2(1-\beta^2-2\beta\alpha)}{(\kappa-1)(1-(\alpha+\beta)^2)}$$

$$+ 4\frac{(n-1-n(\alpha+\beta)^2+(\alpha+\beta)^n)(\alpha-\beta\alpha(\beta+\alpha))}{1-(\alpha+\beta)}$$

$$b = (\alpha-\beta\alpha(\alpha+\beta))\frac{1-(\alpha+\beta)^{2n}}{1-(\alpha+\beta)^2}$$

where κ is the kurtosis of R_t.

The Drost-Nijman formula is the right way to correct conversion of 1-day volatility to *n*-day volatility. According to the results Drost-Nijman, as $n \to \infty$, we have $\alpha \to 0$ and $\beta \to 0$, which means that temporal aggregation produces gradual disappearance of volatility fluctuations. On the other hand, we have scaling which amplifies volatility fluctuations. In fact scaling by $\sqrt{n}$ generates volatilities that are correct on average but it produces false conclusions of large fluctuation in the conditional variance of long-horizon returns. Formal aggregation is the key to converting short-horizon volatility estimates into good long-horizon volatility estimates which is useful if we want to assess volatility forecastability.

Figures 2, 3 and 4 displays for each volatility index, the graphic of the scaled implied volatility (e.g. $VX1\times\sqrt{22}$), the graphic of the scaled GARCH(1,1) volatility, and the graphic of the temporal aggregation of a GARCH(1,1), which yields a 22-day GARCH(1,1) for the VX1 and VIX and a 33-day GARCH(1,1) for the VDAX. We clearly see the differences between scaling and temporal aggregation.

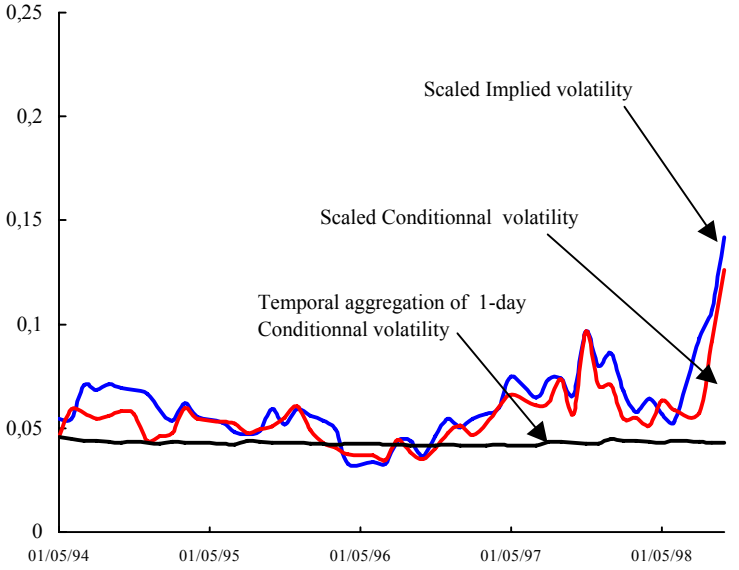
TABLE 7: TEMPORAL AGGREGATION OF THE (22-days) GARCH (1, 1) PROCESS

$$h_{(n),t} = \omega_{(n)} + \alpha_{(n)}\varepsilon^2_{(n),t-1} + \beta_{(n)}h_{(n),t-1}$$

	$\omega_{(n)}$	$\alpha_{(n)}$	$\beta_{(n)}$
FRANCE	0.000400523	0.172039	0.763751
USA	0.000507899	0.212433	0.45464
GERMANY	0.003204971	0.189769	0.253057

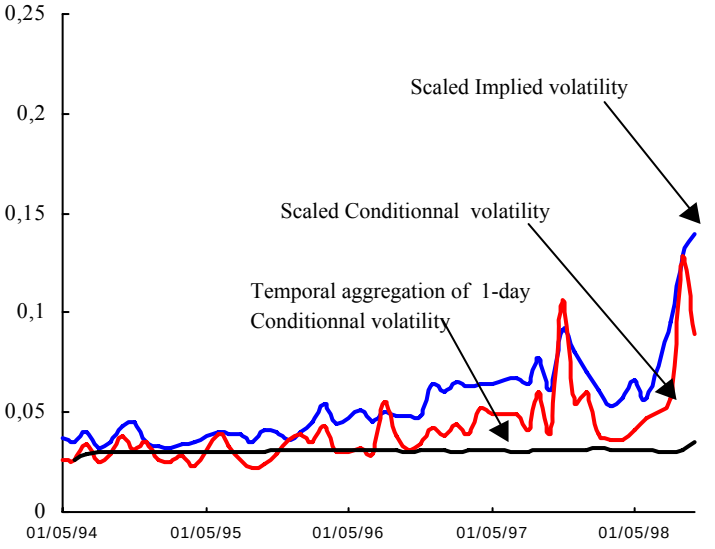
The three following graphics show the effect of the temporal aggregation in relation to the simple scaled measure.

FIGURE 2: REPRESENTATION OF A 22-DAY GARCH (1, 1) - VX1



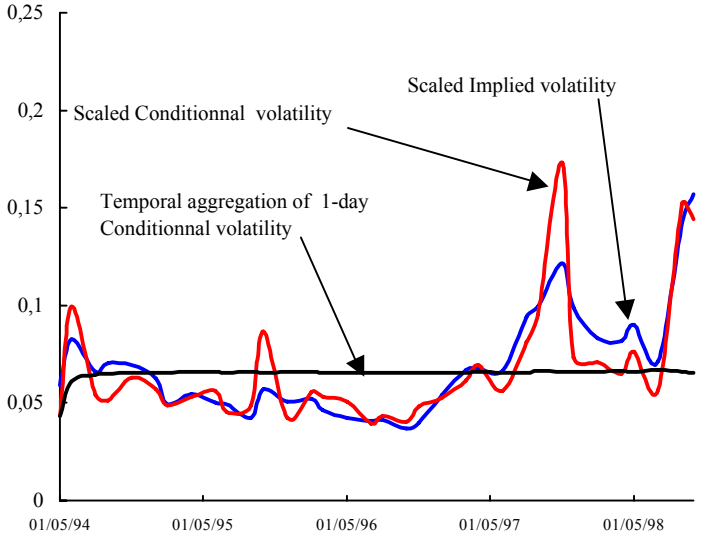
We note that the behavior of the VIX is very similar to the VX1 over the considered period of time, which is not the case with the VDAX that is calculated on a period of 33 trading days instead of 22 for VIX and VX1.

FIGURE 3: REPRESENTATION OF A 22-DAY GARCH (1, 1) - VIX



We see that temporal aggregation reduces considerably the fluctuation around the mean value. It can also be considered that it ignores very short term fluctuations and underestimates short term volatility.

FIGURE 4: REPRESENTATION OF A 33-DAY GARCH (1, 1) - VDAX



4. CONCLUSION

The contribution of this article is to give additional information on the forecasting ability of implied volatility by focusing on the predictive power of ATM international volatility indexes (VX1, VDAX and VIX). This is the first article in which international volatility indexes are used to discuss the implied volatility information content.

We find that VX1, VIX and VDAX are good tools for predicting future realized volatility and future implied volatility. We embed each of the implied volatility indexes as an exogenous term in the GARCH variance equation and found that all of them dominate the GARCH terms, showing the additional information content of the implied volatility over the historical volatility. We also display the difference between the scaling of volatility and temporal aggregation, showing that scaling tends to increase and exaggerate the magnitude of volatility.

REFERENCES

Adjaoute K., Bruand M. and Gibson R., (1998). Forecasting Stock Market Volatility: Does History Matter? *European Financial Management*, Vol. 4, No. 3, 293-319.

Bates, D.S., (1996). Jumps and Stochastic Volatility: Exchange Rate Processes Implicit in Deutsche Mark Options, *The Review of Financial Studies*, Vol. 9, 69-107.

Beckers, S., (1981), Standard Deviations Implied in Options Prices as Predictors of Future Stock Price Variability, *The Journal of Banking and Finance*, 363-381.

Black F. and M.S. Scholes (1973). The Pricing of Options and Corporate Liabilities, *Journal of Political Economy*, Vol. 81, 637-654.

Bollerslev T., (1986). Generalized autoregressive conditional heteroskedasticity, *Journal of Econometrics*, Vol. 31, 307-27.

Canina, L., and S. Figlewski (1993). The Informational Content of Implied Volatility, *The Review of Financial Studies*, Vol. 6, 659-681.

Canstantinides, G., (1994), Option Prices with Transaction Costs, Unpublished working paper. *University of Chicago*.

Chiras, D.P., and S. Manaster, (1978). The Information Content of Options Prices and a test of Market Efficiency, *Journal of Financial Economics*, Vol. 6, 259-282.

Chritensens, B.J., and N.R., Prabhala, (1998). The Relation between Implied and Realized Volatility, *Journal of Financial Economics*, 125-150.

Christofferesen, P., F., and F., X., Diebold and T., Schuermann, (1998). Horizon problem and Extreme Events in Financial Risk Management, *Financial Institutions Center* - The Wharton School - University of Pennsylvania.

Cox J.C., Ross S.A. and Rubinstein M., (1979). Option pricing: A simplified approach, *Journal of Financial Economics*, Vol. 7, 229-63.

Day T.E. and Lewis C.M., (1992). Stock market volatility and informational content of stock index options, *Journal of Econometrics*, Vol. 52, 267-287.

Diebold F.X., Hickman A., Inoue A., and Shuermann T., (1998). Converting 1-day volatility to h-day volatility: scaling by root-h is worse than you think, working paper, *Wharton University*.

Diebold, F.X., Schuermann, T. and Stroughair, J., (1998). Pitfalls and Opportunities in the Use of Extreme Value Theory in Risk Management, in A.-P. N. Refenes, J.D. Moody and A.N. Burgess (eds.), Advances in Computational Finance, 3-12. Amsterdam: Kluwer Academic Publishers. Reprinted in *Journal of Risk Finance*, 1 (Winter 2000), 30-36.

Drost F.C. and Nijman T.E., (1993). Temporal aggregation of GARCH processes, *Econometrica*, Vol. 61, 909-927.

Duan J.C., (1995), The GARCH Option Pricing Model, Mathematical Finance, Vol. 5, No. 1, 13-32

Engle R., (1982). Autoregressive conditional heteroskedasticity with estimates of the variance of U.K inflation, *Econometrica*, Vol. 50, 987-1008.

Fama E., (1965). The behavior of stock market prices, *Journal of Business*, Vol. 38, 34-105.

Fleming, J., (1998). The quality of market volatility forecasts implied by S&P 100 index option prices, *Journal of Empirical Finance* Vol. 5, 317-345

Feinstein S. (1992). The Hull and White Implied Volatility, working Paper, *Boston University.*

Figlewski, S. (1994). Forecasting Volatility Using Historical Data, Manuscript, Stern School of Business, *New York University.*

Fleming, J., B. Ostdiek, and R.E. Whaley (1995): Predicting Stock Market Volatility: A New Measure, *The Journal of Futures Markets*, Vol. 15, 265-302.

Heston S.L., (1993). A closed-form solution for options with stochastic volatility with applications to bond and currency options, *Review of Financial Studies*, Vol. 6, 327-343.

Hull J. and A. White (1987). The Pricing of Options on Assets with Stochastic Volatilities, *The Journal of Finance*, Vol. 2, 281-300.

Hull J. et White A., (1988). An analysis of the bias in option pricing caused by stochastic volatility, *Advances in Futures and Options Research*, vol 3, Greenwich, CT – JAI Press.

Jorion, P. (1995). Predicting Volatility in the Foreign Exchange Market, *The Journal of Finance*, Vol. 50, 507-528.

Lamoureux, C.G., and Lastrapes, W., (1993). Forecasting Stock Return Variance: Towards understanding stochastic implied volatility, *Review of Financial Studies,* Vol. 6, 293-326.

Latane, H.A., and R. Rendleman, (1976). Standard Deviations of Stock Price Ratios Implied in Options Prices, *Journal of Finance*, Vol. 31, 369-381.

Mandelbrot B., (1963). The variation of certain speculatives prices, *Journal of Business*, Vol. 36, 394-419.

Merton R.C., (1976). Option pricing when underlying stock returns are discontinuous, *Journal of Financial Economics*, Vol. 3, 125-144.

Merton R., (1980). On estimating the expected return on the market: an exploratory investigation, *Journal of Financial Economics*, Vol. 8, 323-361.

Newey, W., and K. West, (1987). A Simple Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix, *Econometrica*, Vol. 51.

Scott, E., and A. L. Tucker, (1989). Predicting Currency Return Volatility, *Journal of Banking and Finance*, 839-851.

Sheikh A., (1991). Transaction data tests of S&P 100 call option pricing, *Journal of Financial and Quantitative Analysis*, Vol. 26, 459-75.

Whaley R.E. (1993). Derivatives on Market Volatility: Hedging Tools Long Overdue, *The Journal of Derivatives*, Vol. 1, 71-84.

White, H. (1980). A Heteroskedasticity-Consistent Covariance Matrix and a Direct Test for Heteroskedasticity, *Econometrica*, Vol. 48.

Wiggins J., (1987). Option values under stochastic volatility: theory and empirical estimates, *Journal of Financial Economics*, Vol. 19, 351-372.

The Cyprus Journal of Sciences

NOTES FOR CONTRIBUTORS

The Cyprus Journal of Sciences is a refereed publication with an international character and a broad perspective. The journal aims to cover a wide spectrum of areas of interest, including among others, Humanities and Social Sciences, Pure and Applied Sciences, Economics and Management. It will publish empirical, theoretical and methodological articles. Survey research, commentaries and book reviews are also of interest. Papers submitted to *CJS* should not be under concurrent consideration at another journal.

Manuscripts should begin with a cover page indicating the title of the paper and the full address (i.e., author's name, affiliation, address, telephone number, fax number, and email address) for each author. The second page should repeat the title and contain an abstract of no more than 100 words. The text should begin on page 3 and as far as possible should not exceed 7,000 words. Affiliations and acknowledgements should appear as a footnote at the bottom of the first page and should be preceded by an asterisk. Where possible, affiliations should include the author's department and institution. Footnotes should be labeled NOTES and should appear at the end of the main text. Bibliographies should be labeled REFERENCES and should be listed alphabetically at the end of the main text. Authors should adopt the following style:

Arestis, P. and Demetriades, P. (1997). Financial Development and Economic Growth: Assessing the Evidence, *The Economic Journal*, Vol. 107, 783-799.

Enders, W. (1995). *Applied Econometric Time Series*, John Wiley & Sons, Inc.

In the text itself, these should be cited either:
Arestis and Demetriades (1997) and Enders (1995) or (Arestis and Demetriades, 1997, p. 789) and (Enders, 1995, p. 145).

Appendices should appear after the notes but before the references. The typeface for notes, appendices and references should be smaller than that used in the main text. Further authors' guidelines can be downloaded from the journal's website (http://www.ac.ac.cy/research/publication.html). Authors may submit their papers electronically to research@ac.ac.cy in Microsoft Word format. The attachment must be ONE file that includes all components of the manuscript (i.e., title page, abstract, paper, endnotes, appendices and references). Alternatively manuscripts can be submitted via mail. If mailed, authors should include a copy of the manuscript on standard A4 paper and a disk containing ONE file that includes all components of the manuscript. Papers are acknowledged upon receipt.

Manuscripts should be submitted to:

Charalambos Louca, Editor
The Cyprus Journal of Sciences
Americanos College
2 Omirou Avenue
Eleftheria Square
P.O.Box 22425
1521 Nicosia
Cyprus