



Research Centre_
Prague College

Bulletin of the Prague College Research Centre

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Preface

The Prague College Research Centre (PCRC) was founded with the idea of developing interdisciplinary research crossing several fields and subject areas underlying the academic curricula at Prague College, its main purposes are:

- › To promote a medium of participation and discussions by means of regular interdisciplinary workshops and seminars.
- › To promote and to encourage the collaboration among different Schools and programs in the design and creation of multidisciplinary courses in the College.
- › To provide a means of publishing research work for both students and staff as part of a quarterly academic bulletin and e-journal.
- › To cooperate with other education institutions and organizations in the development of common projects of interest.

The Centre was developed from projects initiated by Stefano Cavagnetto in the context of his role as Head of the School of Business and the School of Computing, by Bruce Gahir, Principal Lecturer in the School of Business and Computing, and by Pascal Silondi, Director of Libat and Principal Lecturer in Interactive Media. Beginning in 2009 research in the following areas has been initiated:

1. Game theory and its application to economics, business, philosophy and international relations.
2. The history of programming languages and history of computers.
3. Experimental media (Prague College and the PCRC is an associate partner for Underground City XXI, an international interdisciplinary EU project).
4. The history of cryptology and the science of enciphering.
5. Art and mathematics: a profitable relationship in history-from classical geometry to fractals and topology.

By combining academic study with practical training the PCRC aims to create an environment where personal achievement goes hand-in-hand with social responsibility. Strategically, this offers students the chance to actively collaborate in several research areas with the support of faculty members and lecturers of the College.

Beginning in March 2010, a quarterly Bulletin will be published detailing progress in relevant research activities of lecturers and students. This bulletin forms an integral part of the PCRC and provides a medium whereby the research activities of the centre can be documented. Faculty members, Lecturers and students belonging to every School of the College are welcome to submit their work for publication. Deadlines for submission for next issues in 2010 are:

- › 30/06/2010
- › 28/09/2010
- › 31/12/2010
- › 30/03/2011

Editor:

- › Stefano Cavagnetto <stefano@praguecollege.cz>

Computing and Business Editorial Board:

- › Bruce Gahir <bruce.g@praguecollege.cz>
- › Andy Cousins <andy.c@praguecollege.cz>
- › Dave Gannon <dave@praguecollege.cz>
- › Veronika Doucova <veronica.d@praguecollege.cz>

Fine Arts and Design Editorial Board:

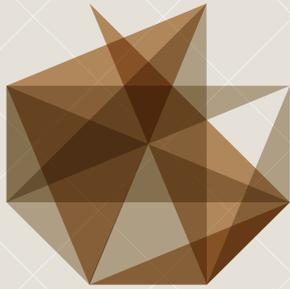
- › Pascal Silondi <pascal.s@praguecollege.cz>
- › Simon Gray <simon.g@praguecollege.cz>
- › George Allen <george.a@praguecollege.cz>
- › Jorge Boehringer <jorge.b@praguecollege.cz>

Production Department:

- › Marie Silondi <marie.s@praguecollege.cz>
- › Dmytro Strapchev <dmytro.strapchev@praguecollege.cz>
- › Anna Boguszak <anna@praguecollege.cz>
- › Julie O'Shea <julie.o@praguecollege.cz>
- › Natalia Ogneva <natalia.ogneva@praguecollege.cz>
- › Gavin Bird <gavin.b@praguecollege.cz>
- › Amir Kudaibergenov <amir.kudaibergenov@praguecollege.cz>

To submit your work, please contact the project coordinator of the PCRC:

- Venera Muftakhova <venera@praguecollege.cz>
- Masa Hilcisin <masa@praguecollege.cz>



UCXXI
INTERDISCIPLINARY PLATFORM



Education and Culture DG

Culture Programme

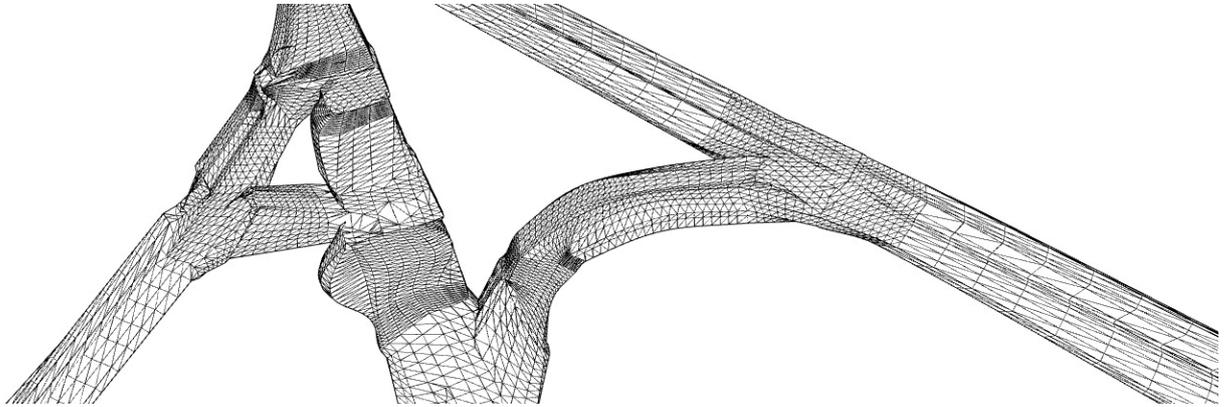
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european cultural foundation

Part I:

Underground City Project (EU Project)



The European Interdisciplinary Platform Underground City (XXI) originates from a long-term project "Underground City XXI". The aims of this project include the protection of an ex-coal mine in Labin and Rasa, in the Region of Istria, Croatia and the conservation of its industrial and architectural heritage. This project was initiated in 1998 by the cultural and art association Labin Art Express (L.A.E.) and the Region of Istria. The goal of the project is the transformation of an ex-coal mine into a modern, underground town, with streets, bars, galleries, a swimming pool, shops, restaurants, children play-grounds, Museum of Coal Mining, and other components of a modern town including Government, Statute, Mayor, police, laws and regulations, following the historical tradition of the Republic of Labin in 1921. The main idea of the project was to provide an ample and true testimony of the nearly 400 year old tradition of mining, transforming an ex-coal mine's heritage into an avant-garde cultural and art project with a strong economic and social impact and potentially to become one of the leading Croatian cultural and tourist attractions, and a generator of future local/ regional development. Construction of the first underground town in the world in the 8th "horizon" (level) of the ex-coal mine (10 km long, app. 50.000 m² of space, 160 meters below ground surface), would demonstrate how space exploitation can be treated as environmental preservation.

In the summer of 2007 the cultural & art association L.A.E.(Croatia) in cooperation with art association LIBAT (France), NOMAD theatre (Austria) and Prague College (Czech Republic), established the project "Interdisciplinary Internet Platform Underground City XXI (UC XXI)" – the creation of a virtual, 3D futuristic underground town and establishment of a specific European cultural and interdisciplinary community.

Internet platform UC XXI, a 3D multi-user environment shared and distributed on Internet, will consist of: an interactive tour through highly developed spatial/urban plans and experimental architectural models of fundamental city buildings including the Museum of Industry and Mining, a City Hall, an exhibition gal-

lery, a movie theatre, a cultural centre, public spaces, public institutions and executive bodies (in the form of specific avatars). The Underground City community with citizens and residents, Statutes, regulations and laws, moral and ethical codes will form permanent communication and social networks. Mixed media art works and hybrid performances will be created by the residents and guests of the virtual underground town.

In 1993 Podlabin (Labin Downtown) pit was officially recognized as a national monument of culture. In September 1998 Cultural Centre "Lamparna" (future entrance of the "Underground City") was opened in one of the abandoned mine buildings. In December 1998 the Assembly of the Region of Istria proclaimed Underground City XXI "millennium regional project". In the year 2000 the Faculty of Mining, Geology and Oil in Zagreb provided technical expertise, which proved the technical feasibility of the project in the areas of security, ventilation, water and electricity supplies as well as lifts and other means of transport. The entire project development is divided into six different phases from conceptual work on the definition of the interdisciplinary platform to the dissemination of the project's eventual results.

Phase 1. Definition of the Interdisciplinary platform (artistic, social and technological)

The virtual community's statutes, regulations, moral and ethical codes, terms for citizenship, beneficiary's rights and obligations, technical and other requirements, as well as different tools, services and facilities to be offered on the platform, will be discussed internationally and interdisciplinary by inviting European artists, scientists, programmers, other experts and officials to propose the first model for the future platform. This will be accomplished with a regard to artistic, social, political, legal, economical and technological issues. Available tools, technologies and already existing communities such as blaxxun, Second Life, or Active Worlds will be studied and evaluated to enable the definition of a strategy

that meets the requirements of the UCXXI community relating to collaborative work, art production and implementation of mixed media content within interactive 3D real time environments on the Internet, in particular:

- › Various tools will be presented relating to 3D modeling techniques as well as open source, gnu, or other well known software. These tools will be evaluated from the perspective of usability.
- › Various languages and applications like VRML/X3D, Java, 3D games engines, OpenGL, DirectX, will be presented and evaluated for quality and network usability.
- › Various communication technologies will be evaluated to meet the requirements of the UCXXI network, regarding interactivity, collaborative work and virtual Internet communities. Functionalities being explored include real time content manipulation, audio/video streaming, chatting and shared database management.

Phase 2. Definition of architectural and spatial/urban model of the future 3D environment

The basic virtual city infrastructure will be defined, synthesizing various already realized studies from the Faculty of Mining in Zagreb and using existing digital data provided by laser measurements of the coal mine provided by VIAS in Vienna. An interdisciplinary European expert team will be established to develop proposals for some spatial/urban units with streets, squares, parks, buildings, to design fundamental 'public' buildings like museums, theatres, City Hall, galleries, cultural centres, to propose and integrate various means of transport such as lifts, railways, cycle and walking tracks, as well as some other infrastructure, in preparation for the 3D model construction Phase.

Phase 3. Creation of the 3D Model

3D artists and programmers in a close relationship with architects and designers will create the first 3D model of the Underground City XXI based on the real dimensions and situation of the ex-coal mine, using advanced CAD techniques and the results of the previous mine studies and measuring. They will collaborate in experimentation and integration of architectural studies, installations and utopian architecture projects as well as in adaptation of gained proposals and ideas to be optimally integrated into the future 3D virtual environment.

Phase 4. Development and implementation of the real-time multi-user platform for delivery of shared interactive 3D content on the Internet

Programmers will directly collaborate with an expert team to enhance the potential of virtual 3D environments and provide an advanced multi-user server platform. A server for computer aided

architectural design within real-time multi-user 3D platform will be provided, enabling users and community members to visualize and communicate their proposals. The UCC XXI platform will provide community communication tools such as chatting, forums, message boards and clubs as well as extensive multi-user functions with membership members and profile management and will integrate web 3D formats such as 3D, 2D, audio, video and streaming media. Regarding technology, UC XXI platform will utilize networked 3D rendering engines, with performance comparable to 3D game engines, which support character animation (avatars), which will enhance social experiences as well as web 3D content visualization. Programmers directly co-operating with expert groups and artists will integrate 3D models developed during Phase 3 into multi-user environment shared and distributed on the Internet.

Phase 5. Dissemination (a): Creation and public presentation of mixed media art works and performances, in between real and virtual spaces

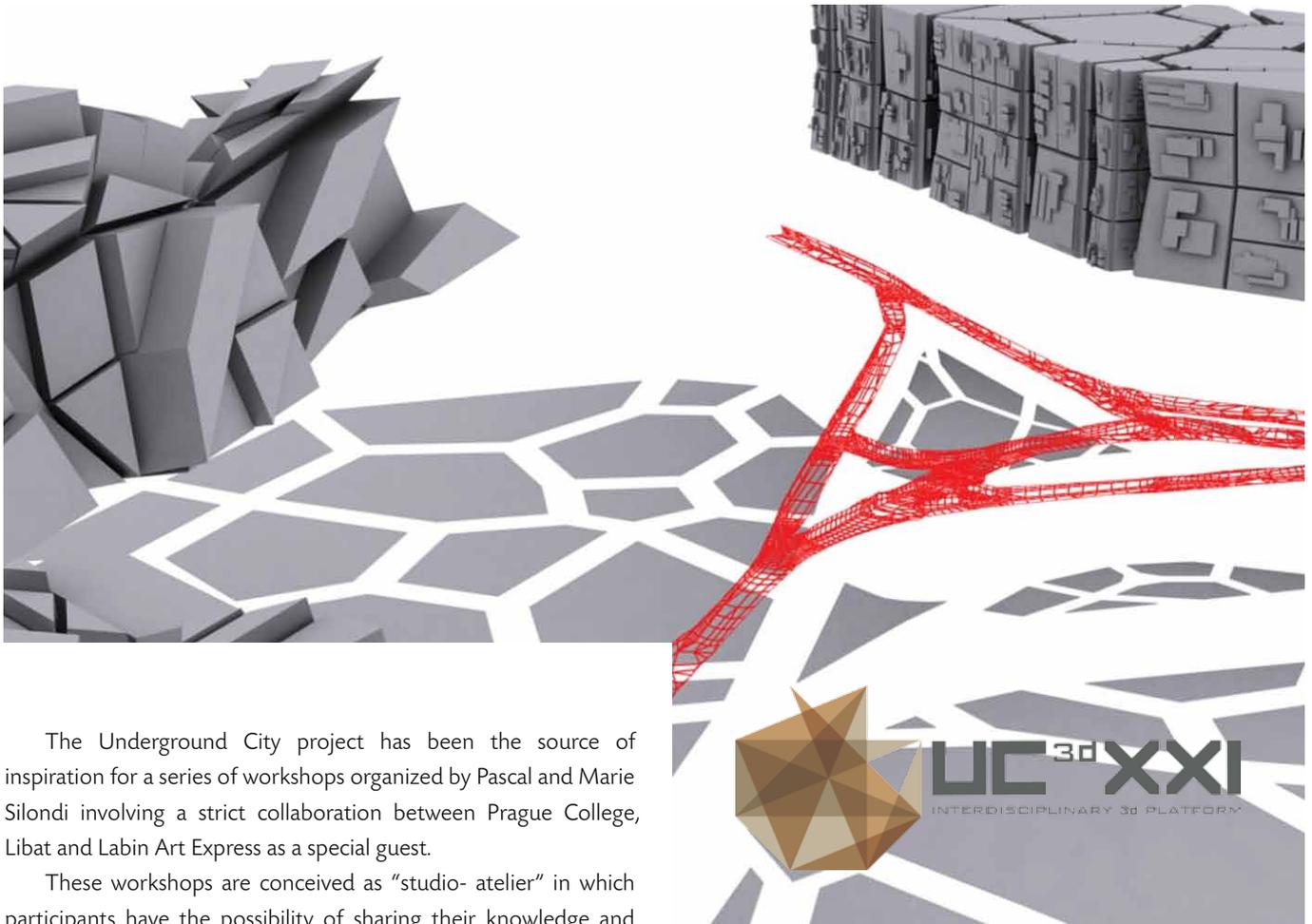
Artists will experiment and create mixed media works in sound, video, 3D volumes, 3D architecture, texts, images, 2D and 3D animations, for example, that will be implemented in the UCXXI platform, in order to stimulate and promote the artistic and cultural dimension of the project. Artists will thus also initiate inter-connection with other artistic forms, based on real-time experimentation with image processing, contemporary poetry, performance, contemporary music events, broadcasting of independent radio programs, robotic installations and other experimental media. This inter-connectivity will help to modify existing creative strategies and make the revolutionary step into the age of mixed reality.

Phase 6. Dissemination (b): Communication/Promotion

The communication strategy is based on the establishment of a trademark "Underground City XXI" and use of different promotional tools. The organisation of seminars, festivals, internationally announced conferences; website (such as www.undergroundcityxxi.com, www.artservis.org, www.artfactories.net, and other European cultural websites) and banners on some internationally popular websites, announcements and press releases for each project's activity in regional, national, and European printed and electronic media, production and public presentations of multimedia art works and performances, digital and printed brochures for UCXXI, flyers and posters, T-shirts, caps, stickers, badges and similar products with UC XXI logo. Endorsements from UCXXI supporters such as well known artists, musicians, actors, models, sportsmen and other popular public figures, and public presentations of the initial and finalized platform will take place in Zagreb, Prague, Venice, Ljubljana, Belgrade, Vienna, at new media/electronic art festivals and events in Europe as part of a public communication strategy.

Underground City in process_

The Prague College-Libat workshops-public events and the Underground City Project



The Underground City project has been the source of inspiration for a series of workshops organized by Pascal and Marie Silondi involving a strict collaboration between Prague College, Libat and Labin Art Express as a special guest.

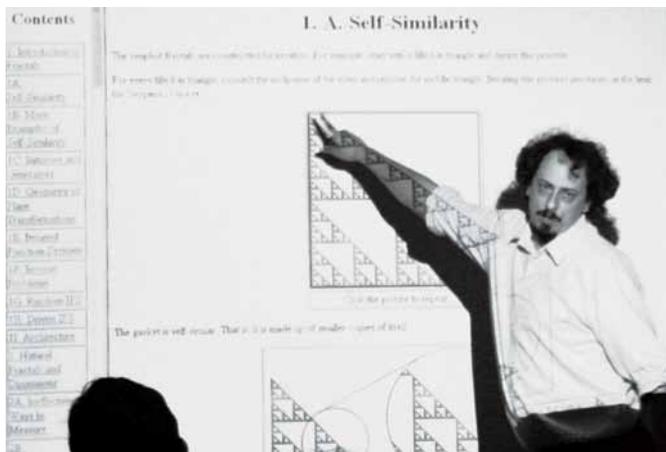
These workshops are conceived as “studio- atelier” in which participants have the possibility of sharing their knowledge and skills coming from several different backgrounds.

Three workshops have been organized at Prague College Studios since the beginning of the project (Workshop 1 held on the 12th of December 2009, Workshop 2 held on the 30th of March 2010, Workshop 3 held on the 3rd of July 2010). The main aim of these events is to create a moment in which participants can discuss, share their experiences, present their results and work together in order to develop the entire project in a very stimulating environment. The workshops are characterized by practical and theoretical sessions in which lectures and seminars are integrated with concrete experimentation of different elements composing the various areas of the project. The workshops always conclude with a public exhibition event presenting what has been achieved in the previous months and weeks of intense collaborative work.

Below we propose a summary of the theoretical underpinning of the previous lectures given in the first three workshops. The activities and a discussion of the practical work can be found in the first issue of the Bulletin which extensively discussed the experimentation on

the Unity game engine and the 3D platform. In the first workshop a lecture was given by Stefano Cavagnetto titled “The conception of the Self in Multiple Cyber Worlds”. The talk mainly regarded questions concerning personal identity when an augmented cyber reality is taken into account. And some of the concepts from anthropology were applied to the study of Cyberspace. In the second workshop a public lecture was given by Bruce Gahir and Stefano Cavagnetto regarding artificial agents and morality. Artificial agents, particularly those in cyberspace, extend the class of entities which can be involved in moral situations. Several arguments were presented in order to show that such agents can be conceived as moral agents. Bruce and Stefano used the fundamental principle of a “level of abstraction” (LoA) as defined by Luciano Floridi as a key-concept in order to develop their work. Then they continued to expand upon the idea of an artificial agent as an information object that has intrinsic value and hence moral worth. Finally, they reviewed the consequences of the above approach for artificial agents in cyberspace and concluded

that the framework provided by Floridi is a pluralistic approach that is essential to the development of global information and computing ethics at the cross-cultural level. In the same workshop a second lecture was delivered regarding the chemical structure of the coal as a possible computational grid for artificial (digital) organism. The chemistry of coal is connected to Cellular Automata and the structure of chemical groups of the coal is implemented as a computing grid for running cellular automata. The famous Game of Life is then run by adopting a new definition of neighborhood on the defined computing grid. This lecture was given by Stefano Cavagnetto in a seminar format at Prague College. It's an interesting connection which shows how cellular automata can be used at the macroscopic level to model architecture and at the microscopic level to model molecular structure. This reflects a sort of perception and deeper intuition about a possible order and pattern which we can find on the edge of complexity, but also a better understanding of techniques where a simple rule iteratively applied on a computer may generate an immensely complex behaviour simulating that of nature. In the third workshop Stefano Cavagnetto gave a lecture about automatic crypto machines particularly the talk focusing on how the crypto-machine Enigma works and on its internal structure from a mathematical point of view. He also explained the conceptual consequences on how this structure may be used to generate "different types of space".



List of artworks presented during the workshops' open doors:

UC3D environments (2010)

By Pascal Silondi (France), Jakub Grosz (Czech Republic), Rajmond Berisha (Kosovo).

Lamparna prototype (2010)

Interactive installation

by Pascal Silondi (France), Marie Silondi (Czech Republic), Tihana Valent (Croatia), Jakub Grosz (Czech Republic), Rajmond Berisha (Kosovo), Yevgeniya Drovossekova (Kazakhstan).

Real time 3D environment light tracking and sensible floor

Neuron prototype (2010)

Interactive installation

by Jakub Grosz (Czech Republic), Peter Marenčík (Slovakia), Pascal Silondi (France), Rajmond Berisha (Kosovo).

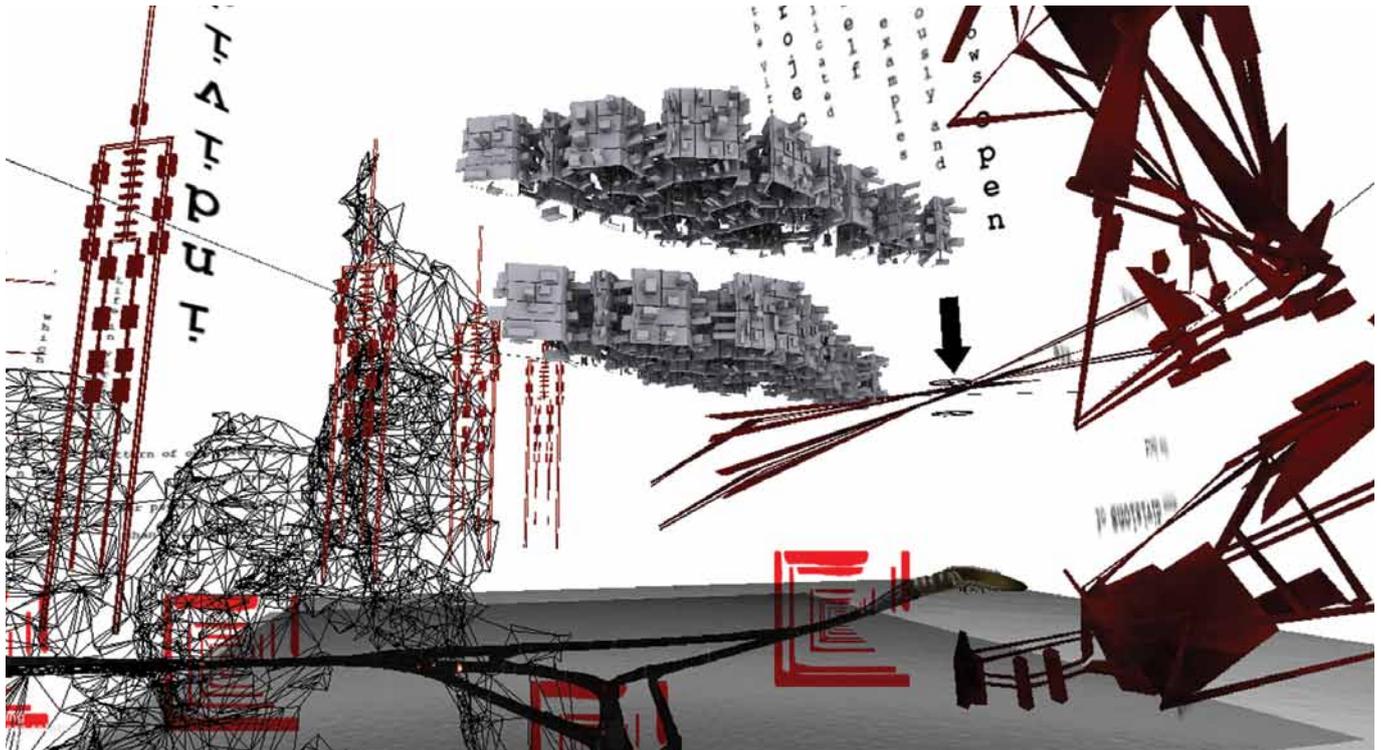
Real time 3D environment multi-touch interface

These artwork prototypes were also presented in the third Prague workshop but in an advanced state.

The partner's visualizations were also exhibited during the third Prague workshop and presented other interpretations of how the Underground city could potentially look like such as architectural studies during UCXXI workshop in Labin, Croatia, in May 2010 and animation of architectural sketches.

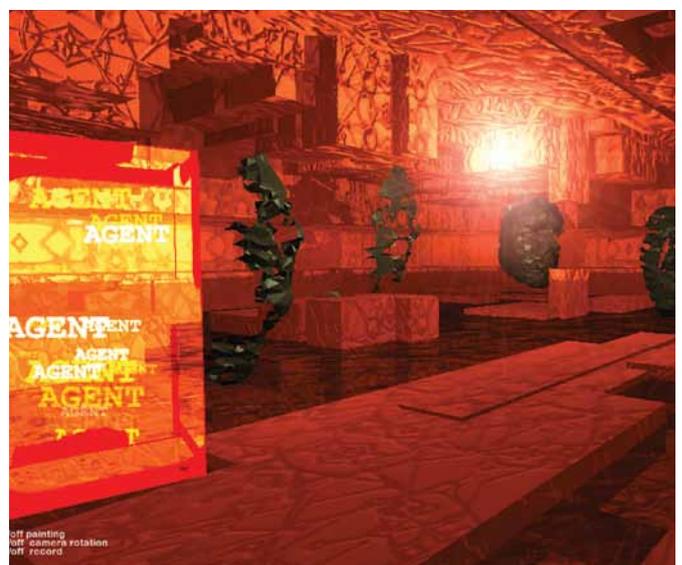
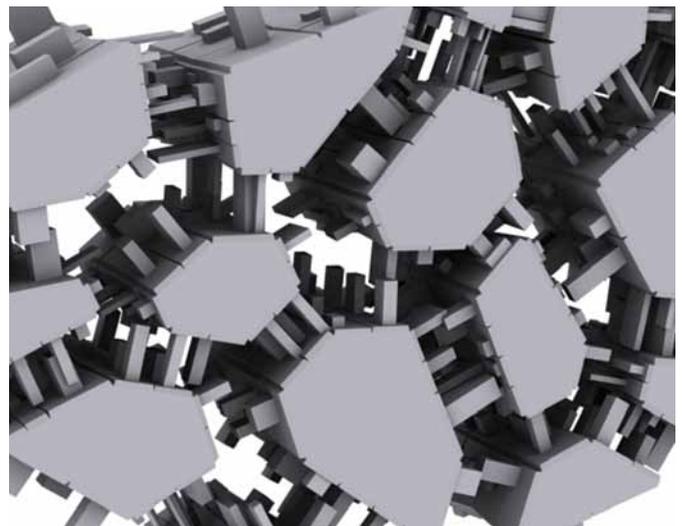
The interdisciplinary collaboration also involves external entities of Prague College.

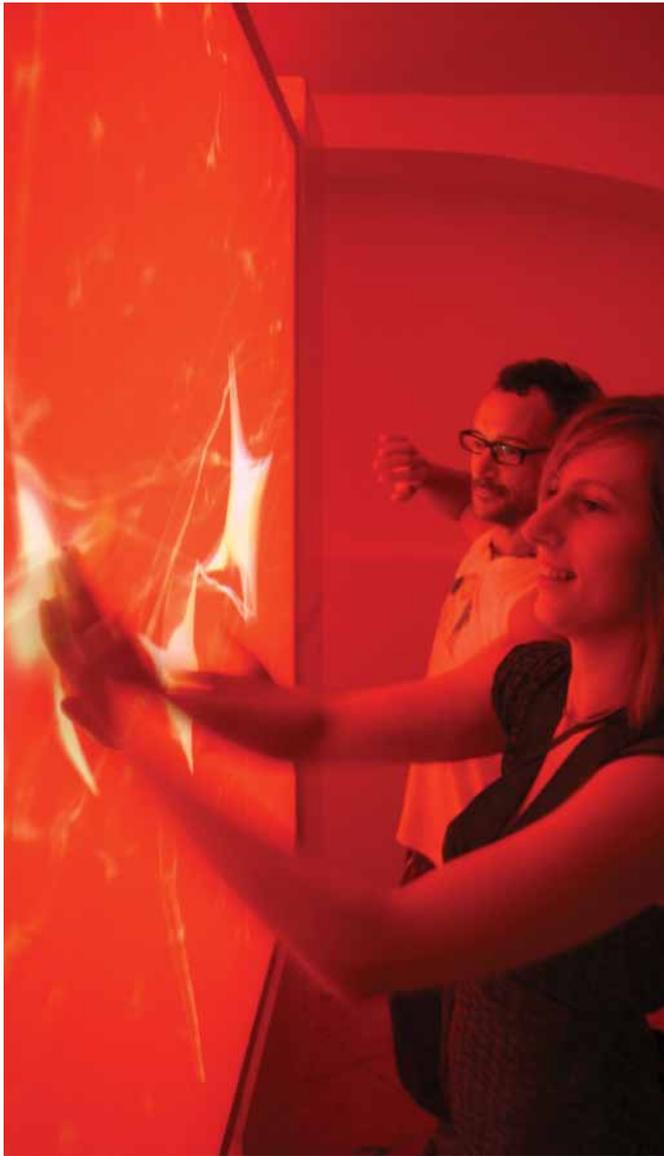
During the third workshop Jonáš Krýzl (Academy of Arts, Architecture and Design) and Jan Císař (Czech Technical University in Prague, Faculty of Architecture) made a case study of the project interpreted here as an utopian architecture prototype. They worked on the issues of memory and collective memory and the preservation of information connected with the cycles of life and death. They were imagining how there could be a place in the platform as a columbarium where dying "objects" which are about to face extinction could be brought to life again if someone would find them useful or would resurrect them somehow. The columbarium would be then combined with a "natarium" where new things can be brought to life as if the energy of dying objects would be a new essence for new elements. They also imagined it as a database with properties of interacting with visitors and reacting to them according to their feelings. They also got inspired by the interactive installation prototype untitled Neurons and they worked on the idea that tunnel walls would be covered by connected neurons with information flowing between cells. A single information would be then visualized on the cell for a few seconds. The concept is also designed in a way that the visitors would be able to feel the flow of information and control the conditions of the organism. For example, they could slow down the flow to check the single information or just enjoy the feel of the flow around them.



#The new phase and UC3D

Since May 2010, Prague College, Libat, Labin Art Express and Nomad Theatre entered the phase of building Underground City 3D environments which aims to establish a specific cultural, artistic and educational virtual community structured as an online collaborative and interdisciplinary 3D platform. Underground City 3D (UC3D) is part of the longer project "Underground City XXI platform" which until now, has been developing workshops/laboratories in order to first define research and experiment what would be the future 3D digital environment and community. UC3D will be developed and implemented on the Internet as a futuristic and utopian 3D City inspired by European industrial history using the potential of contemporary multi-user game technologies to create and present new type of mixed-media art works and performances that interconnect virtual and real environments. UC3D is a transnational agora which will connect interactive media artists, architects, programmers, designers, interdisciplinary researchers and students through a series of workshops, seminars and laboratories to imagine, create and share alternative models for building future European multicultural communities and elaborating new citizenship principles with the public participation. The Underground City 3D (UC3D) purpose is to now use and enhance the potential of the interdisciplinary network developed in the last years to concretely create mixed-media art works, to implement them as part of the platform as a City organization, and to open the digital city to the general public on the Internet. It will also open a public discussion on the issues of building new forms of societies by implying European citizen participative reflexion.





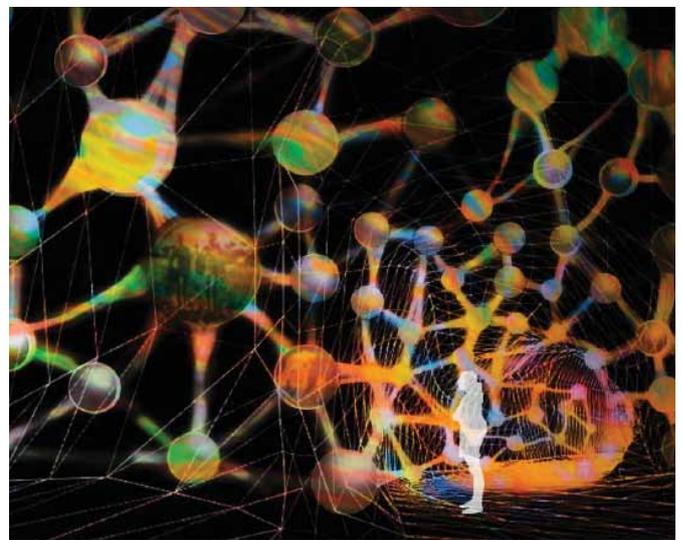
The exhibitions proposed a space for the presentation of the project, with explanation texts, documentation and publications produced in the frame of the project. A retrospective of UCXXI/UC3D activities and results was shown through an illustrative slide show, displaying pictures from the mines, photos of the workshops, performances and artworks as well as key words or expressions connected with the project fields.

The public could visit the latest developed 3D environments and experiment the new user functionality enabling a specific interaction with the space, where they could re-size and remodel the paths and participate in public communication where messages were mobile and perceptible in the whole world as part of the whole city flux. Two prototypes of interactive installations which are connecting the virtual UC environments to the real space were presented, Lamparna and Neurons.

The latter is an Interactive installation developed collectively during last Underground City workshops by Libat and students of Prague College. Neurons is a multitouch modular screen displaying

3D environments composed by a network of neurons which can be re-organised, deleted, re-sized and rotated. The screen is made in a stretch textile. In order to interact with the neurons, the "participative viewer", has to place his/her hands in contact with the screen and coordinate his/her movements in order to move the objects by sliding them or to re-size them by placing both hands on the opposite edges of the neuron and bringing them closer or moving them apart.

The connection of neurons reminds us how, from the infinitely small to the infinitely big everything is part of the network and complex systems. Neurons installation is a metaphor of all types of networks, from the network of information with continuous flux of messages to the network of the city. It provides a representation of the world and the conception of it into a system. It evokes, for example, the system of binary codes of the



displayed images. It can also refer to the body system which can be defined as a complex organism composed by a flux of information from stimuli to reaction.

The network is here also considered as a rhizome, in the sense defined by Deleuze and Guattari, which is not made from units but from moving directions. The rhizome is a proliferation of multiplicities, and it is always in the middle, between things, inter-being or intermezzo. The installation is interested in presenting the "in-between". It does not aim to focus on the neurons by themselves but on the flux, on what is happening between them, on the in-between. A flux is also present between the image's internal space, its external one and the visitor. The external space corresponds to the actualised surface which is visible in a particular time and space and on a specific visual aid. The internal one is the computer binary coded model. It is then possible for the viewer (we will call him/her participant, since he/she active in the interaction with the installation) to work in the internal space of the digital image through the external space. His/her body is directly connected with the internal space. He/she involves his/her body through the connection between his/her hands and

the textile but also through the gesture of his/her whole body. The fluidity of that gesture is intensified by the softness and stretchiness of the textile leading to a certain sensuality in the movement.

Neurons installation is multiplying the sensorial experience, implying the vision connected with sound and touch which are intensifying each other getting close to the point of synesthesia. The artwork screen is like a skin which the participant has to caress and which feeling invites to snuggle down. The connection between the artwork and the participant is highly strengthened by the resort of evocation of comfort and intimacy.

Moreover this contact seems extended by the fact that the screen stretch enables the participant to enter his hands inside the screen. It deals with the old fantasy-idea to "go behind the screen" while the participant is in an other place and doing it a certain way by actually modifying the image content. What used to be inaccessible

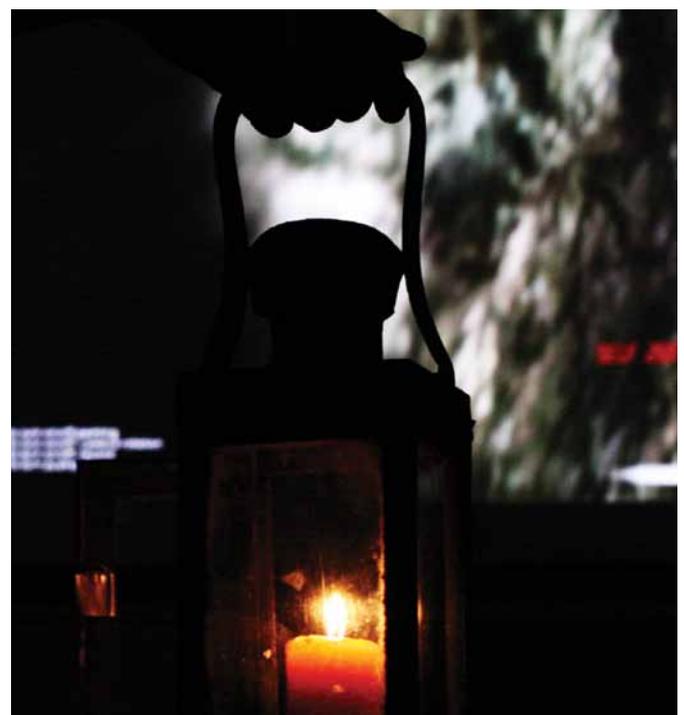


by the viewer is now within his/her reach. Moreover, by reorganising the neurons system the participant has the illusion to manipulate the living. The artwork is a metaphor of contemporary considerable issues such as the modeling of the living and artificial life, from genetic modification, through the technological devices programmed according to living being cognition to the interconnection between human beings and machines as, for example, the interactive installation. The artwork is making a call on its meta-communication on what is actually happening while using it. It asks where are the limits and the frontier between artificial and living beings, between the machines and the humans. While some of the last discoveries are highly questioned whether they could be used in our world according to ethical issues, we are integrating in our everyday life some technologies of which some are entrelaced with the living and so change our societies, our modes of representation and practices. The point is not to be frightened as soon as we hear about any technological aspect, following the pessimistic science fiction scenarios, but more to continuously wonder why, how and in which contexts these novelties should be implemented and why, how the

mutations they engender should happen.

Neurons participates in a really interesting new way of representation which is this connection of image and volume. By interacting with the image through the stretch textile the participant is working in a space like a sculptor where he/she models the screen quietly. It is a truly visionary way to deal with 3D projection, where the screen is also a 3D perspective. The participant mental projection of the virtual 3D space is also accompanied with a movement in the space and in the deepness of the representation. In this type of new interfaces and information architecture this idea is quite pertinent now since it takes the physical 3D movement in real space connected to the 3D virtual world into consideration.

Neurons was presented in Underground City workshop in July 2010 as a prototype but already demonstrates promising research results in terms of human/computer interface and 3D representation.



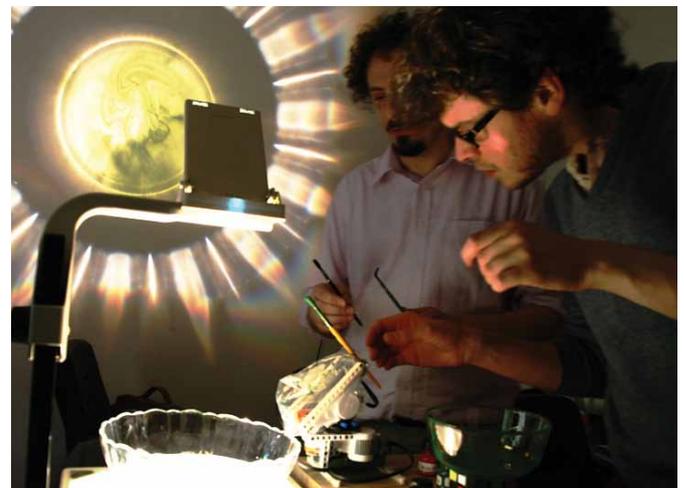
The mediation of the project was highly discussed during the conception of the exhibitions because of its particularity, its complexity and its interdisciplinarity. Moreover, we know that one part of the public is following the public events of UC3D/XXI very closely, while another part is new to the project. We had to combine a presentation which would explain the whole project but at the same time would not be repetitive to those who are already familiar with it. For this reason the scenography was set up in a progressive way that would offer complementary elements step by step to understand the whole project. It was also really important to imagine a comfortable place where the audience could choose documents free for consultation and where social interactions could happen. Mediators, people active in UC3D/XXI, were exchanging information with the audience and answering questions. Also, the public had the possibility to take part in this collaborative and interdisciplinary European project and to participate in the exhibition by writing or drawing on a piece of paper how the project was inspiring them. This was then hung on the wall. Open doors were really successful since each time we saw more and more people attending the events and participating in the discussions about the project. Around 100 people attended the last exhibition and many expressed their interest and proposed ways how to collaborate.



#Underground City Project as inspiration for a multidisciplinary course combining Art and Computing

The Underground city project has been a source of inspiration for a class at Prague College since Spring 2009. The main aim of the class is to combine knowledge and skills coming from the Interactive Media and Computing programs. In particular, students should imagine an interactive system, using sensors and programming languages to control behaviors of two robots in reality and to control behaviors of their avatars in the digital environment. The digital environment can be a computer Game and/or a multi-user 3D environment shared on internet based on the Underground city project.

In this class students work with robots and sensors, with a digital environment, possibly a 3D model, and game principles. The final result of the class is a prototype for an interactive installation. Using simple technology such as the NXT Lego students build two robots and experiment in the laboratory the functionalities and the use of sensors. In this phase students experiment with at least two different programming languages. The first is a language coming with the NXT computer, which is a visual programming language in which most of the basic functionalities of regular programming languages are available (control structures, etc.). The second language is a visual language



as well, but for a more general purpose, the Visual Programming Language (VPL) by Microsoft. VPL is an application development environment designed on a graphical dataflow-based programming model. Rather than a series of imperative commands sequentially executed, a dataflow program is more like a series of workers on an assembly line, who do their assigned task as the materials arrive. As a result VPL is well suited to programming a variety of concurrent or distributed processing scenarios. For educational purposes, especially when the class is supposed to work in a team, this type of language is excellent since it is mainly designed for beginner programmers with a basic understanding of concepts like variables and logic. Thus, it is easy to begin the work in teams even when there are elements with very little knowledge about programming. It should be noted

that VPL is not limited just to novices. The programming language may appeal to more advanced programmers for rapid prototyping or code development. The language offers the possibility to control and program the NXT computer via Bluetooth communication.

The class is then integrated with a practical part in which students can create self made devices using sensors to control robotic behaviour. The second part of the class moves to the virtual environment and the modelling work. In this part students work with game engines (Unity and 3D Rad mainly) and enter the world of game design. In particular, the formal system and the narrative approach are considered in some detail and the possibility of different approaches to game design are clearly outlined. The aim of this part of the course is that of building a bridge between the physical world where we live and the digital world we construct. The bridge is provided by a representation through the idea of avatars for the physical robots. Thus a full correspondence can be built. The class ends with an interactive installation that may be presented to the public in an exhibition or at the studios of the college. In the installation robots meet an interactive digital environment. The interactive system enables the user to control robots by using self made devices integrating different types of analogical sensors and immersive world technology created with 3ds Max and game engines.



The course has a high experimental approach and is a combination of aesthetics and computing, mostly programming and human-computer interaction. Aesthetics comes from the Greek *aisthiki*, derived from *aisthesis* (i.e., which means perceived by the senses). In the history of aesthetics, before Kant's *Critique* and including Baumgarten's introduction of aesthetics, in the 18th century, art and aesthetics have not been well connected. Art was generally not associated with aesthetics, and aesthetics as an area within philosophy was not focused on art. Since Kant's treatise, aesthetics has been expanded to encompass both the logical and the perceptual. With the advent of computers and computer graphics, this conjunction between the logical and the perceptual has gone to extremes. The connection allows us talk

about the aesthetics of computing as a possible field of research where the interaction is the key-bridge between the logic of a computer system and a perception of its outcomes. In this way an art work is made essentially of two basic dimensions. First, from a philosophical point view, it is defined as an idea, form, or language. Second, psychologically, one can define art with top-down and bottom-up conceptions.

On the subject of computing, it is important to stress the relationship between mathematics and computing. Computer science is founded on core elements of discrete mathematics; thus, we can view aesthetic computing as encompassing a number of mathematical concepts, especially areas involving formal grammar, language notation, geometry, and topology. Discrete mathematics along with the algebraic extension to automata theory is the basic knowledge required for implementing a computing development. Mathematics establishes the formal infrastructure in which mathematical concepts and abstractions can be related to basic computing concepts. Thus, much of aesthetic computing naturally corresponds with mathematical formalism. The benefits of such a definition is mainly that in this perspective we can represent programs and data structures with customized, culturally specific notations. Also we can incorporate artistic methods in typically



computing intensive activities, such as scientific visualization and finally we can improve the emotional and cultural level of interaction with the computer. This is the main approach behind the course named *Interactive Media Design and Authoring*.

The interesting fact about the course is that it had very positive feedback on the *Underground City Project* itself. In fact, the mathematical abstraction contained in some part of the development is evident and it deals with discrete mathematics, fractal geometry and cellular automata theory. The following long reflection and analysis, regarding the vision of the fractal city and the city as an organism as well as the concept of spatial justice is the result of this type of synergy between the project and education at the university.



#A Fractal Model of the Underground City UCXII Project

We will begin by tracing the various changing conceptions of how space and time have been abstracted across the broad sweep of human history. Our tendency to continually abstract through simplification manifests itself in the way we use mathematics to portray order and regularity. The way we conceive time as a continuous flow, and the way we perceive space as composed of simple geometries. But this is rapidly changing and we are entering a time when many of these traditional notions are being

intensely scrutinized by the framework of fractal geometry. It has been discussed extensively that living cities have intrinsically fractal properties that are in common with all living systems. Our intention is to propose a similar fractal nature for the Underground City project (UCXII) and develop a viewpoint of an organism as a consequence of such a fractal structure in the process expanding upon the application of the notion of spatial justice as a guiding principle that originates due to such fractal properties.

Introduction

From the earliest examples of the written record, there is evidence that human being has always made sense of the world through powerful simplifying abstractions which seek out the underlying principles and order in our experiences and perceptions. The power to abstract is one which probably sets the human beings aside from the rest of the animal kingdom and it is clear that the ability to impress order and structure on diverse phenomena though casting aside detail irrelevant to the quest in hand, is strongly correlated with our conventional view of human progress. In short, abstraction leads to theory and theory enables the kernel of any phenomena to be isolated, defined and thence explained. From prehistory, such abstraction has been associated with the power to simplify the world visually and from the earliest cave paintings, the human beings has sought to impose smooth geometry on art so that its meaning can be communicated in the simplest and most effective way. Taking the city as an example, life

in any city can be thought of as being directly dependent upon its matrix of connections and substructure, because the geometry either encourages or discourages people's movements and interactions. We can therefore say that the geometrical structure of a city has an influence on its life. Such a depiction is crucial for understanding the structure of cities in cyberspace like the one being developed as part of the Underground City (UCXII) project. It has been claimed that the enormous conceptual gain results from thinking of a city as a multiple fractal structure, Batty & Longley and Frankhauser.

Urban typologies used throughout history up until the twentieth century lead automatically to a fractal structure as detailed by Salingeros. Traditional urban form follows the pedestrian transportation web and the predominantly pedestrian city was built over time with continuous incremental additions on a fractal model, without its builders being aware of it. It has also been claimed that the

human mind has a fractal model imprinted in it, so what it intuitively generates will have a fractal structure as detailed by Mikiten et. al. We propose that such conceptual frameworks can also be applied to virtual cities and the interconnection of tunnels in the virtual Underground City can similarly follow a fractal model incorporating the notion of spatial justice.

A Fractal Model for the Underground City

The city itself can be seen as a living organism. Fractal modelling offers a method that develops predictive models of how cities may grow under different conditions. Fractal models that have been developed to possess the same reproduction characteristics of organisms like the sponge and coral are of great inspiration in the development of cities. Further, fractal structures are predominant in nature and have been studied extensively to assist towards our understanding of the form of organisms and cities. This fact begs the question as to whether all organism and cities could be modelled in a similar way, or could the city be a by-product of the iteration process inherent in fractal geometry since random factors added to the fractal equation can result in fractals closer to the 'real' world. There is a significant evidence to indicate that great buildings of the past, and the vernacular (folk) architectures from all around the world, have essential mathematical similarities. One of them is a fractal structure: there is some observable structure at every level of magnification, and the different levels of scale are very tightly linked by the design. In contradistinction, modernist buildings have no fractal qualities; i.e., not only are there very few scales, but they are different scales that are not linked in any way. Indeed, one can see an unwritten design rule in the avoidance of organized fractal scales. It can be observed that cities, at least the most pleasant ones, are fractal. Everything, starting from the paths and streets, to the shape of facades and the placing of trees, is fractal in the great cities such as Paris, Venice, and London. This has been measured mathematically by people like Michael Batty and Pierre Frankhauser.

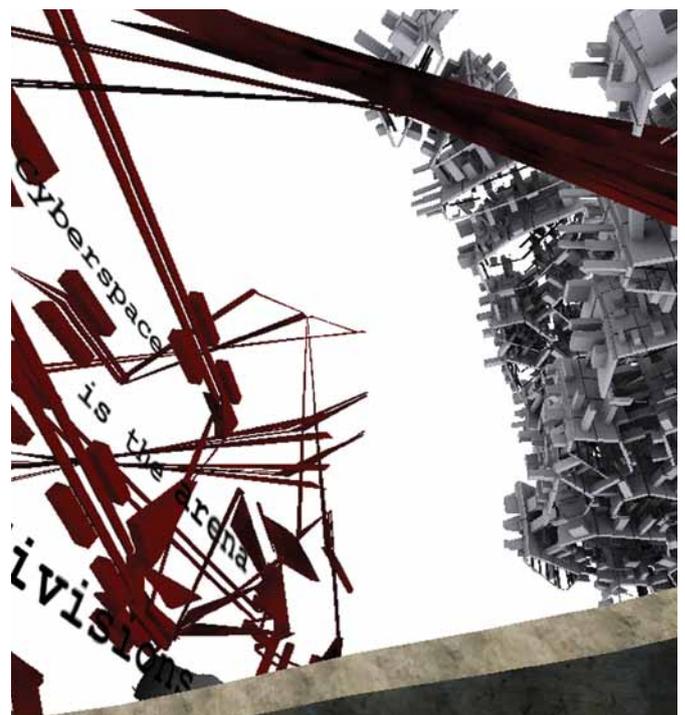
The science of fractal geometry has emerged during the last ten years. Fractal objects are irregular in shape but their irregularity is similar across many scales thus enabling them to be described mathematically, and to be generated computationally. Fractals cannot be described using the geometry of regular figures based on points, lines and planes – Euclidean geometry. It is now well known that the morphology of cities is fractal. Over the past twenty years a particular view has been gaining ground, this is that insight not prediction must be the goal of science. This has been spurred on by discoveries in mathematics that simple, deterministic systems, from which equally simple and incontestable predictions have always been assumed, are not predictable in the traditional sense.

The fact that simple systems were manifested with a level of complexity that was completely unknown went some way to explain why more complex systems, which were often built from simpler elements were entirely unpredictable, in fact even chaotic. Cities,

the weather or stock markets are all examples which demonstrate chaotic behaviour under certain conditions, whose traditional models were unable to yield predictions with scale and form known in advance. In mathematical terms, this is largely due to the fact that the mathematical space within which such models operate is so convoluted and infinitely divisible that it is impossible to guess the accurate starting position of systems within this space.

Fractals can assist in the understanding of "natural" or "organic" growth systems that can be used to understand the structure of cities. Cities that grow naturally are formed from a myriad of individual decisions at a much smaller scale than those which lead to planned growth which invariably embody the actions of somewhat larger agencies. Planned cities or their parts are usually more monumental, more focused and more regular, reflecting the will of one upon the many or at best, reflecting the will of the majority through their elected representatives.

Organically growing cities develop much more slowly than those which are planned, also organic development involves both growth and decline, while planned change is more asymmetric, frequently embodying growth but rarely dealing with decline. Thus in this sense, a more complete picture of a virtual city can be based on natural or organic growth interwoven both in space and time by planned structures, as depicted by figure 1 below. The system of underground tunnels in the Underground City networked together in organic form underlying a fractal structure would be representative of natural growth. In terms of visual and statistical order an organic form of such a virtual city, when viewed in plan form would resemble cell growth. For the Virtual Underground City (UCXII) such cellular growth of networked tunnels weaving in and out, closely following the virtual underground terrain and



other natural features may seem geometrically irregular, but this does not imply "disorder". Such naturally growing structures of a virtual city are in fact more workable, more efficient and more equitable. Indeed more democratic embodying the principle of spatial justice to be elaborated in the section below.

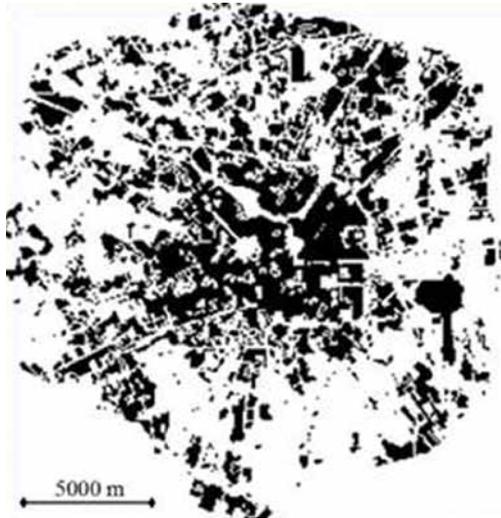


Figure 1: A study of the metropolitan area of Milan

The Fractal City Viewed as an Organism

Although Life is very likely the most complex phenomenon in the Universe, many of its most fundamental and complex phenomena scale with size in a surprisingly simple fashion. It can be shown that such basic underlying principles embedded in the dynamical and geometrical structure of space-filling, fractal-like, hierarchical branching networks are presumed to be optimised by natural selection. These ideas lead to a general quantitative, predictive theory that potentially captures the essential features of many diverse biological systems that can be used to understand the development of virtual cities.

In 1952, the British mathematician, Alan Turing, wrote a seminal paper that developed these ideas. In it he hypothesized that to understand the mechanism of development in plants and animals, which was essential to investigate how basic processes interacted. These processes were collectively known as the reaction diffusion mechanism. To illustrate this process, Alan Turing as a founder of computer science proposed a model where two homogeneously distributed solutions would interact to produce stable patterns during morphogenesis. These patterns would represent regional chaotic differences in the concentrations of the two substances and these interactions would produce an ordered structure out of random chaos. Similarly, a well known mathematical model called as the L-system was proposed by the biologist Aristid Lindenmayer in 1968. Two principal areas of application of L-systems include generation of fractals and realistic modelling of plants.

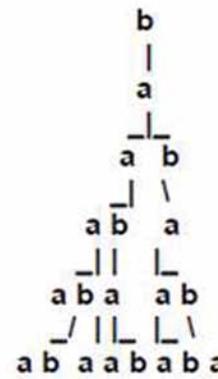


Figure 2: Formal definition of a DOL System

The L-systems is about the notion of rewriting, where the basic idea is to define complex objects by successively replacing parts of a simple object using a set of rewriting rules. The simplest example of the L-system is a DOL-system. The following example given by Prusinkiewicz and Lindenmayer (1991) (see figure 2) lets us consider strings built of two letters a and b (they may occur many times in a string). For each letter we specify a rewriting rule. The rule

$a \rightarrow ab$ means that the letter a is to be replaced by the string ab, and the rule $b \rightarrow a$ means that the letter b is to be replaced by a. The rewriting process starts from a distinguished string called the axiom.

Let us assume that it consist of a single letter b. In the first derivation step (the first step of rewriting) the axiom b is replaced by a using production $b \rightarrow a$. In the second step a is replaced by ab using the production $a \rightarrow ab$. The word ab consists of two letters, both of which are simultaneously replaced in the next derivation step. Thus, a is replaced by ab, b is replaced by a, and the string aba results. In a similar way (by the simultaneous replacement of all letters), the string aba yields abaab which in turn yields abaababa, then abaababaabaab, and so on. We soon arrive at the magnificent pictorial representation as shown in figure 3.

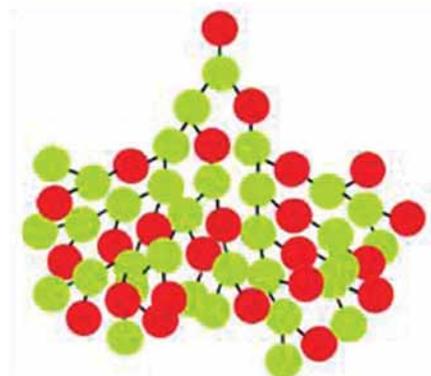


Figure 3: A graphic model of the DOL-system in Fig9. where b is a red spot and a is a green spot

These ideas can be extended to social organisations: to what extent are cities or corporations an extension of biology? Are they

“just” very large organisms? Analogous scaling laws detailed above, reflecting underlying social network structure, point to general principles of organization common to all cities, but counter to biological systems the pace of social life systematically increases with size. This has dramatic implications for growth, development and particularly for sustainability: innovation and wealth creation that fuel social systems. Just as the cardiovascular network distributes energy and materials to cells in an organism, urban road networks distribute energy, materials and people to locations in cities.

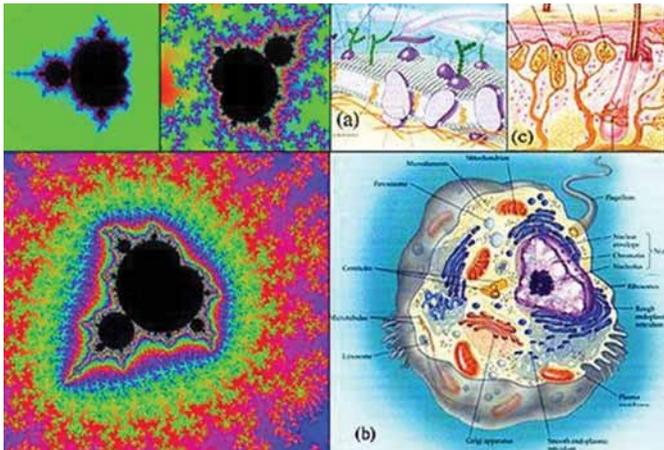


Figure 4: Depicting similarities between fractals and natural forms

Understanding the topology of urban networks that connect people and places leads to insights into how cities are organized and such concepts can be extended to virtual city networks where the connectivity of material flows can be visualized via DOL system networks.

Spatial Justice and the Fractal City

The organization of space, a crucial dimension of human societies, reflects social facts and influences social relations as detailed by Lefebvre. Consequently, both justice and injustice become visible in space. In other words, the analysis of interactions between space and society is necessary to understand social injustices and to formulate territorial policies aiming to tackle them.

The specific term “spatial justice” has not been commonly used until very recently, and even today there are tendencies among geographers and planners to avoid the explicit use of the adjective “spatial” in describing the search for justice and democracy in contemporary societies. Either the spatiality of justice is ignored or it is absorbed (and often drained of its specificity) into such related concepts as territorial justice, environmental justice, the urbanization of injustice, the reduction of regional inequalities, or even more broadly in the generic search for a just city and a just society.

This so-called spatial turn is the primary reason for the attention that is now being given to the concept of spatial justice

and to the broader spatialization of our basic ideas of democracy and human rights, as in the revival of Lefebvre’s notion of the right to the city. Whereas the concept would not have been easily comprehensible even five years ago, today it draws attention from a much broader audience than the traditionally spatial disciplines of geography, architecture, and urban and regional planning.



Figure 5: Spatial Analytics depicting the social class groups in London (The red areas indicate higher social class groups)

Thinking about space has changed significantly in recent years, from emphasizing flat cartographic notions of space as container or stage of human activity or merely the physical dimensions of fixed form, to an active force shaping human life, one such representation of social forces generating fractal imagery can be seen in figure 5. A new emphasis on specifically urban spatial causality has emerged to explore the generative effects of urban agglomerations not just on everyday behavior but on such processes as technological innovation, artistic creativity, economic development, social change as well as environmental degradation, social polarization, widening income gaps, international politics, and, more specifically, the production of justice and injustice in spatial locations. Figure 5 above depicts the social class groups in the city of London, the red areas indicating the upper social class groups occupying significant areas in the center of London, note the fractal nature of the image.

It can be said that critical spatial thinking today hinges around three principles:

- 1) The ontological spatiality of being (we are all spatial as well as social and temporal beings).
- 2) The social production of spatiality (space is socially produced and can therefore be socially changed).
- 3) The socio-spatial dialectic (the spatial shapes the social as much as the social shapes the spatial).

Taking the socio-spatial dialectic seriously means that we recognize that the geographies in which we live can have negative as well as positive consequences on practically everything we do. Foucault captured this by showing how the intersection of space, knowledge, and power can be both oppressive and enabling. Building on Foucault, Edward Said states the following:

“Just as none of us are beyond geography, none of us is completely free from the struggle over geography. That struggle is complex and interesting because it is not only about soldiers and cannons but also about ideas, about forms, about images and imaginings.”

In the broadest sense, spatial (in)justice refers to an intentional and focused emphasis on the spatial or geographical aspects of justice and injustice. As a starting point, this involves the fair and equitable distribution in space of socially valued resources and the opportunities to use them. Spatial justice as such is not a substitute or alternative to social, economic, or other forms of justice but rather a way of looking at justice from a critical spatial perspective. From this viewpoint, there is always a relevant spatial dimension to justice while at the same time all geographies have expressions of justice and injustice built into them. Our intention is to utilise the concept of spatial justice to the fractal structure of a virtual city.

Spatial (in)justice can be seen as both outcome and process, as geographies or distributional patterns that are in themselves just/unjust and as the processes that produce these outcomes. It is relatively easy to discover examples of spatial injustice descriptively, but it is much more difficult to identify and understand the underlying processes producing unjust geographies. Locational discrimination, created through the biases imposed on certain populations due to their geographical location, is fundamental in the production of spatial injustice and the creation of lasting spatial structures of privilege and advantage. The three most familiar forces shaping locational and spatial discrimination are class, race, and gender, but their effects should not be reduced only to segregation. Seeking to increase justice or to decrease injustice is a fundamental objective in all societies, a foundational principle for sustaining human dignity and fairness. The legal and philosophical debates that often revolve around Rawls' theory of justice are relevant here, but they say very little about the spatiality of justice and injustice especially in the area of virtual cities. We propose to extend such notions of spatial justice, as discussed above, to the virtual city.

Thinking spatially about the nature of fractal cybercities not only enriches our theoretical understanding, it can uncover significant new insights that extend our practical knowledge into more effective actions where justice plays a greater role in the organization of space, by not making the spatial explicit and assertive, these opportunities will not be so evident.

The prominent psychologist Carl Jung, during the development of his theory of the collective unconscious, hypothesized that the

aesthetic experience in art consists of the elevation of archetypal images towards the conscious mind by means of stimuli generated by artistic objects. These archetypal images are deposited in the collective subconscious. Jung proposes that, just as the human body conserves the traces of our mammalian ancestors, the human mind maintains images imprinted in the deepest part of our psyche; structures and models that were captured during our evolutionary process. Our instinctive judgments are directed by universal archetypes, which were configured by the interaction of human beings with their surroundings during the distinct stages of our evolution. These ideas are supported by current research in evolutionary biology, brain physiology and cognitive science. These disciplines come together in what we may call evolutionary psychology, providing a picture of how the mind evolved over millennia to adapt to the changing world. There is a continuous link from the earlier unconscious action routines of other animals, to the development of language and the conscious mind.

Our view is that there should be support from psychology for what defines a good building or city that supports organic form depicted by fractal geometry. The fractal structure of nature clearly follows from mechanisms of physical interaction and the evolution of matter. So, we could similarly infer that the structure of our psyche, the collective subconscious of Jung, is essentially fractal. This great reservoir of our ancestral memories have to be structured in the most economical way, not only to allow an almost unlimited capacity, but also with many interconnections to facilitate the free flux of information. What could be more suitable to this than a fractal structure? If this is so then our discussion above concerning the proposed fractal structure of the Underground City would evidently point to the direct relationship between an organism structure and the notion of spatial justice. Uniform fractal scaling laws reflecting an underlying social network structure within the city point to a general form that has a fundamental notion of spatial justice.

We have made use of the word 'form' extensively already without attempting any definition, for in one sense, the term is self-evident: as D'Arcy Thompson implies, form means shape, and in this context, shape pertains to the way cities can be observed and understood in terms of their spatial pattern incorporating the notion of spatial justice as detailed above. In fact, we will need to reflect a little more deeply on the word because our usage here implies a certain approach to geometry and space as well as process and function.

The word 'form' has many meanings, such as shape, configuration, structure, pattern, organization, and system of relations. Here we are interested in these properties only in so far as they are clearly set in space, which is the usage we will follow. Form is broader than shape per se, although our immediate and first attack on its measurement and understanding is through the notion of shape, in the outward appearance of things. In terms of the study of cities, form will represent the spatial pattern of

elements composing the city in terms of its networks, buildings, spaces, defined through its geometry mainly, but not exclusively, in two rather than three dimensions.

It is therefore our intention to propose that a fluid expression of form is depicted by the fractal generation of

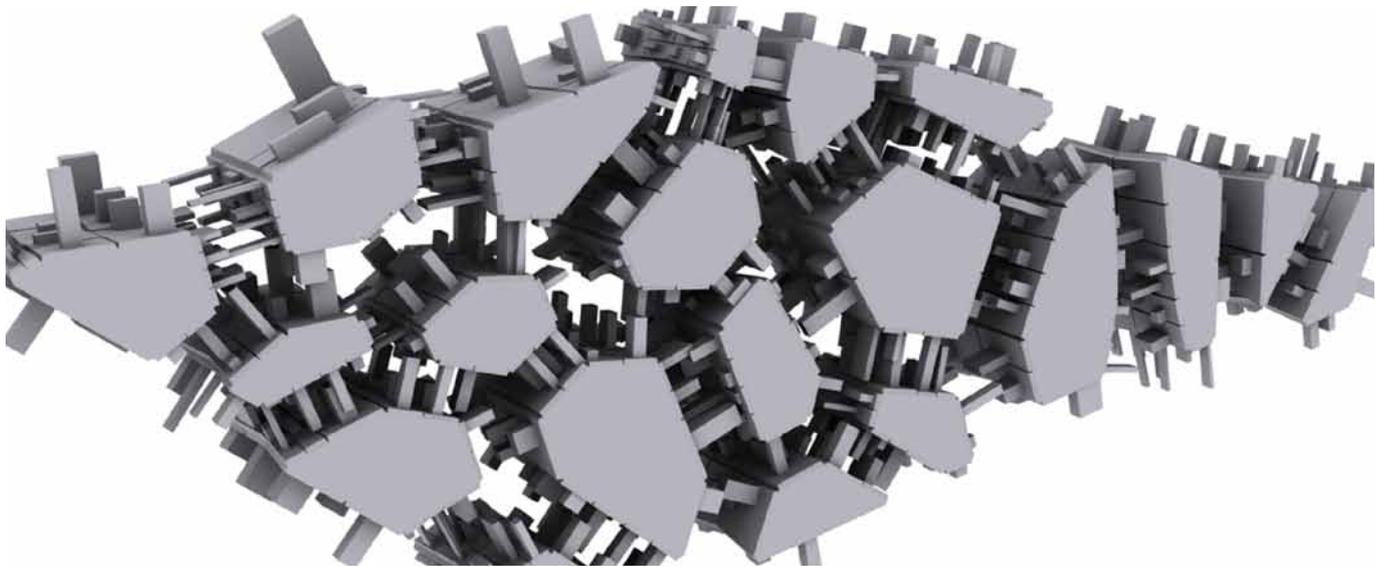
spatial structure and this in turn is associated with organic properties that incorporate the notion of spatial justice. Using the example of the virtual Underground City we propose that such a fractal structure would incorporate the notion of spatial justice as detailed above.

Pascal Silondi (School of Art and Design, LIBAT)

Bruce Gahir (Schools of Computing and Business)

Aurélie Besson (UQAM, University of Quebec in Montreal, LIBAT)

Stefano Cavagnetto (Schools of Computing and Business)



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Underground City XXI

Underground City XXI is an enigma, an untidy vision of infinite possibility. It is a puzzle of both indeterminate size and proportions—one whose basic structure will ultimately determine its form, and whose individual pieces will ultimately determine its function.

I walked away from my first introduction to the Underground City project with more questions than answers. Unable to completely direct my thoughts, I started to travel back to my childhood. Strapped into a chair, I started to move through the (now defunct) “Horizons” attraction at Epcot Center in Orlando, Florida. Beginning with the visionary conceptual musings of Jules Verne, and moving forward through a series of hypothetical visions of the future, the ride forced the viewer to confront the relationship between dreams and reality. Building up in this way, the ride eventually forced the participants to split up, to choose between three very different visions of the future “to visit”: Space colonization, Ocean colonization, and Desert inhabitation. Powerful as it was to my childhood imagination, the ride had its end. The car came to a stop, the seat bar raised up, I got off, and I ran to stand in line for the next attraction. In some ways I still see myself as that same child. Life is a series of beginnings, middles, and ends. Too often our memories of the past, situations in the present, and hopes for future, are dictated

by the way we simply put these moments together in a linear stream, simply letting the current move us forward to the next series of beginnings, middles, and ends.

Underground City XXI is an Eddy in that stream; it is an island, a channel, a choice. Perhaps the ideas represented by the project were forged long ago within the tunnels themselves, or perhaps they are the remnants of the spirit of the striking miners who put everything on the line as they declared themselves an independent republic in 1921, but regardless of the source, that spirit has found its realization in the hearts and minds of all of those involved with the project today, and will undoubtedly continue to burn within all who involve themselves in the future.

Beyond all question of a doubt, Underground City XXI is alive. Conceived in the past, focused on the present, and looking towards the future, this project will continue to develop and grow. Ideas are not static, and neither are people, so it is no wonder that Underground City XXI is not shy, it is undaunted by the scale of its vision, and unabashed in its belief in itself. The current state is no exception; conceptualization has finally begun to find form both virtually and physically. Existing for so long on the narrow border of dream and reality, Underground City is growing. It is expanding across Europe, it will soon to become bathed in a digital glow, and that luminance will undoubtedly attract more believers along the way.

The strength of Underground City XXI is not in its conception, but in its evolution, its involvement. The diversity of ideas and resistance to a fixed and final vision of how things “should” look, is what make the project stand out, what makes it different. This is pluralism in the healthiest sense— a fluid, multi-user phenomenon giving shape to a basic skeletal form. There is always room for the kitchen to expand as the cooks increase in number. If Prague College is any indication of the way the project is working elsewhere, then I have the utmost faith in its success. Interdisciplinary indeed. The project has already brought together students and faculty from different fields of study towards a common goal, and the interdisciplinary virtual platform currently being developed, will help those goals to expand and flourish. Individual expression has finally found its success in the collective experience of the group.

Like a puzzle, the pieces that make up this vast project will eventually come together to form an image. The exact nature of that image is still to be determined. It is now our job to try and form the pieces, so that sometime soon, people from all over will have the opportunity to help put the pieces together, to build the picture, and to become part of the experience that is Underground City XXI.



Part II:

Aesthetics, Numbers and Algorithms



In this section of the bulletin we present two papers, the first focuses on the notion of a number and the second paper is a short paper that elaborates upon the interconnection between mathematics and the arts, in particular the notions of symmetry and harmony.

The first focuses on the notion of a number and asks an important question, how many numbers are there?

Historically, the development and the extension of the notion of a number came with the development of mathematics – as new things were being computed, new numbers needed to be invented, or discovered. How many numbers do we use today is one key question that is being asked. In order to answer this question, the author takes us on an interesting journey back through the terrain of numbers to look at their historical development and then introduces all the main numbers focusing on a formalised structure.

The second paper by Veronika Douchova examines an interesting connection between Mathematics and the arts, although apparently diverse subjects, they have nonetheless a long history of interconnection. Mathematicians have tried to describe or quantify the pleasing feelings that works of art may induce.

The basic concept “equivalence” is introduced and applied to the area of aesthetics. The main focus of the paper is to show how to apply abstract mathematical reasoning to such apparently subjective concepts as “harmony”, or even “aesthetics” in general.

Both papers have been motivated by developments in the Prague College Research Centre (PCRC), their main aim being to relate fundamental principles from the domain of mathematics to practical work and projects that are being developed by students from the faculties of Graphic Design, Interactive Media and Computing.

Equivalence in aesthetics

“Whoever despises the high wisdom of mathematics nourishes himself on delusion.”

Leonardo da Vinci

Introduction

Mathematics and arts, although apparently diverse subjects, have nonetheless a long history of interconnection. Mathematicians have tried to describe or quantify the pleasing feelings that works of art may induce. In ancient Greece (if not sooner) they formulated an exact criterion for the notion of an esthetically attractive ratio on the line: this is the Golden Ratio, see for example [Hof80], which has become popular in architecture. There are more recent and more mathematical works of this type, for instance [Neš05], [BN07] and [DN09].

In this short paper, I will formulate a general outline of a structural approach to esthetics which subsumes the examples given above. I will show how to apply an abstract mathematical reasoning to such apparently subjective concepts as “symmetry” or “harmony”, or even “esthetics” in general.

The basic concept of this structural outline is “equivalence”. This is a mathematical term, and it is introduced in the following section. The application to esthetics is given in the second section.

What is an equivalence

The concept of equivalence occurs in everyday life, although it is not called that way. Consider the following example.

Lets imagine that we have to prepare a statistical survey concerning some question or problem. The statistical data obtained can be analysed from different angles. We may consider all the respondents as one group. We may distinguish women and men and thus process the answers for those two groups separately. We may divide the respondents even more: according to their education and/or age, ownership of a car, number of children etc.

It is obvious that the more criteria we use, the smaller the groups become (a group of women of age 30–40, with university degree, two children and a car is generally smaller than the group of all women). Notice also that each person can only be in one of the groups, and for each person, there is a group, he/she is a member of.

For the purposes of this article, the most important observation is that if two women are members of the same group (e.g. female, age 30–40, high school, one child, one car), they are considered “equal” from the point of the survey. It does not matter if one is tall and the other small as these attributes are not considered as relevant.

Mathematically speaking, an equivalence E on a domain A is a family of non-empty sets where each two sets are disjoint and each element of the domain A belongs to some set (in our example, A denotes all the people participating in the survey). Formally, E is an equivalence on A if

- $\emptyset \notin E$ (no set in equivalence E is empty)

- $\forall e_i, e_j \in E; (e_i \neq e_j \Rightarrow e_i \cap e_j = \emptyset)$ (two different sets in E are disjoint)

- $e_1 \cup e_2 \cup e_3 \cup e_4 \dots = A$ (the union of all sets in E is exactly the whole domain A)

We say that two members a_i and a_j of A are E -equivalent if they are in the same group, i.e. there exists some e_i such that a_i and a_j are both in e_i and we denote this as $a_i E a_j$. By changing the equivalence E , more members of A can become E -equivalent, and conversely.

It is obvious that the finest equivalence is such that each person constitutes his or her own group. The coarsest is the one when we do not distinguish the respondents at all – thus they are all in one big group, being equivalent according to the survey.

Equivalence in a domain can also be defined as a certain relation. In this case, we understand an equivalence as a set of ordered pairs satisfying the three following criteria.

- reflexive: $\forall a_i \in A; a_i E a_i$ (each element is equivalent with itself)
- symmetric: $\forall a_i, a_j \in A; (a_i E a_j \Rightarrow a_j E a_i)$ (the equivalence does not depend on the order in which we write the elements)
- transitive: $\forall a_i, a_j, a_k \in A; (a_i E a_j \text{ and } a_j E a_k \Rightarrow a_i E a_k)$

As an exercise, the reader may prove that both definitions of equivalence are in correspondence. Here is a hint, (i) if E is an equivalence according to the first definition, define the binary relation E' by $a E' b$ if and only if a, b are in the same set (group), (ii) if E' is an equivalence according to the second definition, define E as the set of all groups which contain E' -equivalent elements.

An application to aesthetics

Let us now return to the art world. The following represents an idea how to understand mathematical aesthetics as an equivalence

E on a class of objects A (think of A is a collection of works of art), where E captures the esthetical equivalence of objects based on

some predetermined criterion. For instance we may look at the equivalence “to be equally symmetric” (here A would typically be geometrical shapes), “to be equally harmonious” (here A would typically be a collection of objects composed of distinct individuals, such as bit map images or sets of notes – music), or “to be equally nice” (A here in principle contains all objects). There are more ways how to describe such equivalence E ; we may for instance look for a function f_E from the class of objects A to the class of “values” V s.t. for

$$\forall a_i, a_j \in A; (a_i E a_j \Leftrightarrow f(a_i) = f(a_j)).$$

We then say that a_i and a_j are equivalent if they have the same value $f(a_i) = f(a_j)$ in V . V changes with A and it captures the intuitive notion of “being nice in some degree”. Little reflection shows that simple V ’s such that $V_0 = \{0, 1\}$ are too crude: the set of values V_0 just divides the set of objects A into two groups: “nice” and “ugly”. More sense makes to consider an extension to a real line, for instance $V_R = [0, 1] \subseteq \mathbb{R}$ will measure the esthetical value by a real number in the interval $[0, 1]$.

Another way how to look at an equivalence E on A is by means of partial approximations. Here we start with the assumption that E is an “ideal” equivalence which is not determined yet, and we want to describe it by means of some approximations. We say that an equivalence I on A approximates E if for every $a_i, a_j \in A$,

$$\text{if } a_i I a_j, \text{ then } a_i E a_j.$$

Note that the identity relation $\text{id} = \{(a_i, a_i) \mid a_i \in A\}$ is a trivial approximation of every equivalence E . We say that an equivalence I^* refines I if

$$I \subseteq I^* \subseteq E.$$

If I approximates E , we say that I is an *invariant* (for E).

Examples of such invariants abound in the history of aesthetics. Take for instance the class of objects A which contains geometrical two-dimensional shapes. Let E be the ideal equivalence which captures the intuitive notion of two geometrical shapes to be equally symmetric. Then if we define I_0 to contain all pairs (a_i, a_j) such that a_i is a translation of a_j , then I_0 is an invariant for E (or we say that E is invariant under I_0). If we define I_1 to contain all pairs (a_i, a_j) such that a_i is a translation or a rotation of a_j , then I_1 is an invariant which refines I_0 .

This direction from invariants to equivalences is in some sense

the converse of the usual mathematical practice which starts from an equivalence and studies the invariants. In aesthetics, invariants are used to look for equivalences.

However, because it is the history of the society its been dealt with here and with something as subjective as aesthetic perception, it would be foolish to hope that such invariants or aesthetical values will be explicitly defined in the history. One had better look for manifestations of these hidden invariants in the works of artists and mathematicians.

Examples of some singled-out concepts, which might be used to study invariants, are golden section, regular shapes such as Platonic solids and other uniform polyhedra. These concepts represent basic geometrical shapes. However, in formulating invariants one must realize the following fine distinction between strictly mathematical point of view and the aesthetical point of view: while in mathematics a regular 21 sided polyhedra should be a distinct concept from a 22 sided one, in aesthetics, they will be in the same group (probably together with a circle). More complicated invariants manifest in more complex pieces of art such as paintings. Still, some interesting conclusions can be drawn here from the aesthetical perception in history. Concentrating for instance on portrait paintings, and “symmetry” of such paintings, any invariants considered purely from the mathematical point of view would need to consider two paintings equally symmetric whenever similarly small differences in symmetry occur at, say, the neck of the person in the picture, or the eye area of the person. However, from the esthetical experience, we know that the eye area is much more sensitive to changes in symmetry than other parts of the face. This has practical applications e.g. in face recognition software which work by first finding shapes which resemble eyes in otherwise unanalysed visual data.

This reflects to the fact that visual perception in general is essentially tied with the subjective and aesthetical mode of perception (confirmed by neurological studies of the human brain, e.g. [Zek02], [Sal99]). Although this is not my primary goal, the work can also be considered as one which shows that by looking at aesthetical invariants we may find useful information about human perception in general.

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How many numbers there are?

What are numbers

The following symbols represent numbers: 1 , 1081 , 0 , -1 , $\frac{1}{2}$, $\sqrt{2}$, π , i . They were chosen randomly just to illustrate the variety of the concept of the number. Some of these numbers seem more natural, some other less so. From the philosophical point of view, none of these numbers exist as real objects – there are all idealized concepts. If π seems less natural than 1 , it is because the concept which π idealizes is more complex

than the concept which is behind the number 1 . Historically, the development and the extension of the notion of a number came with the development of mathematics – as new things were being computed, new numbers needed to be invented, or discovered. How many numbers do we use today? In order to answer this question, we will quickly journey back and introduce all the main numbers.

NATURAL NUMBERS

The natural numbers are the numbers for counting objects: 1 , 2 , 3 . . . There are infinitely many of these: by this we mean that there is no largest natural number. Or equivalently, if n is a natural number, then there is a natural number $n+1$. The collection of all natural numbers will be denoted as \mathbb{N} . These numbers, as the name “natural” suggests, are considered fundamental and beyond an obvious need for a definition. L. Kronecker (1823–1891), a German mathematician and a logician, once said that natural numbers are given from god, the rest of numbers being a man’s creation. Be it as it may, there is still a rather fine question to be asked: do the natural numbers \mathbb{N} exist as a collection in actuality, or do they exist only potentially? This distinction, philosophical in kind, relates to the notion of infinity and tries to distinguish between an infinite collection existing as one ideal object, and a finite collection which we can always enlarge by one more element. In the former case, the collection is infinite (actual infinity), in the latter, it is finite now, but potentially contains all the infinite number of objects (potential infinity). We will subscribe here to

the view that the collection \mathbb{N} really exists as one object (majority of mathematicians share this view, not least because it simplifies the exposition).

What about the number 0 , is it a natural number? Naive intuition perhaps says that no because there is no quantity which is equal to “nothing”. However, on closer look, there are compelling reasons to admit 0 as a valid natural number. There are more structural reasons for this (see below), but there are also reasons of convenience. For instance a simple sentence “Each person in this room has a certain number of coins on him” may fail to be either true or false without the number 0 : if there are people without any money in the class, the sentence simply makes no sense. In other words, we would need to postulate specifically that we assume that every one has at least one coin on him. In the long run and with more sentences like this, the chain of assumptions would be very long and unintelligible for practical purposes.

The structural reasons for introducing 0 are connected with the notion of a *group*, see below.

INTEGERS

Integers are numbers . . . $-3, -2, -1, 0, 1, 2, 3$. . . Again there are infinitely many of these. Integers are denoted as \mathbb{Z} .¹ Unlike natural numbers, negative numbers are no longer accepted without reservations. Some ask questions such as “do the negative numbers really exist?” One can answer back with a similar question: “in what sense do the natural numbers exist?” A natural number is an ideal object with no physical occurrence in the real world, so perhaps we should treat negative numbers similarly: as an ideal object which is useful to make calculations about the real world.

Historically, the first occurrence of a negative number is connected with the notion of a debt. As with the case of 0 , it is theoretically possible to always differentiate whether the value of our credit is some number, or 0 (if 0 were not counted as such), or no number at all, but—we would need to add—there is another person, or a group of persons, who have a credit in the amount equal to the number which we owe. Sounds silly? Imagine how awkward this would be in more complicated situations.

But there are even more compelling structural reasons. To stay with our example, we would like to be able to express by a number the value on our bank account, and do some basic computing: to sum two numbers together and also to subtract one number from another number. Little reflection shows that

¹ Note that natural numbers \mathbb{N} are included in \mathbb{Z} , that is new numbers are added on top of the numbers we already have. This will be case with all extensions: \mathbb{Z} , \mathbb{Q} and \mathbb{R} .

to be able to do this for all numbers, we *need* to introduce negative numbers. Suppose we would like subtract 1000 from 500. Then without the negative numbers, this subtraction would not be defined because there exists no natural number which is equal to $500 - 1000$. In the domain of integers, there is such a number, namely -500 .

There is a fine point here. Notice that the symbol $-$ occurred above in two different contexts: as a *binary* operational symbol between two natural numbers (subtraction, $500 - 1000$), and as a *unary* symbol before one natural number (-500). These two ways of using $-$ are interdefinable. If we know what $n - m$ means for every two natural numbers, then we can define a negative number $-k$ as $0 - k$. Conversely, if we know what $-k$ means for every natural number k , we can define $m - n$ as $m + (-n)$.

In mathematics, we take the unary use $-k$ as the basic one.² The structure $(\mathbb{Z}, +, -, 0)$ is an example of a *commutative group* (relative

to addition $+$) because it satisfies the following four properties for arbitrary integers m, n, l :

- › G1. $m + (n + l) = (m + n) + l$, associativity.
- › G2. $m + 0 = 0 + m$, neutral element.
- › G3. $m + (-m) = (-m) + m = 0$, the inverse element.
- › G4. $m + n = n + m$, commutativity.

Any structure satisfying G1–G3 is called a *group*. If it satisfies also G4, it is called a *commutative, or an Abelian group*. Groups are omnipresent in modern mathematics and physics. An important example of a group in physics is the group of transformations of a solid object (where the operation $+$ means the composition of two transformations, the inverse operation $-$ means the opposite transformation, and 0 denotes the empty transformation, i.e. no transformation at all).

Thus a structural reason for accepting the extension from \mathbb{N} to integers \mathbb{Z} is that \mathbb{Z} behaves like a group, while \mathbb{N} does not.

2 If we took the binary operation $n - m$ as the basic one, this would introduce awkwardness into the simple and elegant axioms G1–G4 below. Unlike $+$, the operation $m - n$ is not commutative: for instance $3 - 5 \neq 5 - 3$. The unary operation $-k$ behaves more elegantly, as spelled out in the axiom G3.

RATIONAL NUMBERS

The rational numbers were first used to represent the notion of “ratio” of two natural numbers, such as $1 : 2$. Notice that $1 : 2$ is the same ratio as $2 : 4, 3 : 6$, etc., that is each ratio has an infinite number of representations. We say a *rational number* instead of a ratio and write $\frac{1}{2}$ instead of $1 : 2$. Since we want to have also the negative rational numbers (for reasons similar as in the case of \mathbb{Z}), we will allow as a rational number any fraction $\frac{m}{n}$ where m, n are in \mathbb{Z} and $n \neq 0$. The collection of all rational numbers is denoted as \mathbb{Q} . Unlike the case of \mathbb{N} or \mathbb{Z} we can no longer enumerate elements of \mathbb{Q} in a simple way as $\dots - q_2 < -q_1 < -q_0 < 0 < q_0 < q_1 < q_2 < \dots$. The reason is that between any two rational numbers, there is an infinite number of other rational numbers: for instance between 0 and 1 there are infinitely many rational numbers of the form $\frac{1}{n}$, where n is a natural number > 1 . A similar argument works for any two rational numbers $q_1 < q_2$.¹ Or put differently, no rational number q has its immediate successor (or predecessor) rational number. We say that the ordering $<$ on \mathbb{Q} is *dense* (while the ordering on \mathbb{N} is \mathbb{Z} is called *discrete*).

In extending \mathbb{Z} to \mathbb{Q} , we wish to preserve what good properties we have, while improving some other properties. This for instance means that $(\mathbb{Q}, +, -, 0)$ is still a group relative to an operation of addition. But \mathbb{Q} is an improvement over \mathbb{Z} because it behaves like a group also relative to multiplication. Analogously to $-$ being an

inverse operation to addition, the operation \div is the inverse to multiplication. Just as with the operation $-$ which we defined to be a unary operation $-k$, the operation of division is rephrased using the inverse operation $^{-1}$, where $q^{-1} = 1 \div q$ for every q in \mathbb{Q} . Notice that \mathbb{Z} is not closed under the operation \div (for instance $1 \div 2$ is not an integer), so \mathbb{Q} really brings something new.

More precisely, it holds that the structure $(\mathbb{Q}, \cdot, ^{-1}, 1)$ behaves like a group if we exclude 0 : for arbitrary rationals q, r, s, t , where $t \neq 0$

- › G1. $q \cdot (r \cdot s) = (q \cdot r) \cdot s$, associativity.
- › G2. $q \cdot 1 = 1 \cdot q$, neutral element.
- › G3. $t \cdot t^{-1} = t^{-1} \cdot t = 1$, the inverse element.
- › G4. $q \cdot r = r \cdot q$, commutativity.

In other words, if we remove 0 from \mathbb{Q} , and denote this as $\mathbb{Q} - \{0\}$, then the structure $(\mathbb{Q} - \{0\}, \cdot, ^{-1}, 1)$ is really an Abelian group.

Thus a structural reason for accepting the extension from \mathbb{Z} to integers \mathbb{Q} is that $\mathbb{Q} - \{0\}$ behaves like a group relative to multiplication, while \mathbb{Z} does not.

Additional strength of \mathbb{Q} becomes apparent if we put together all the operations we have discussed so far. We say that the structure $(\mathbb{Q}, +, -, 0, \cdot, ^{-1}, 1)$ is an example of a *field*, and all-important algebraical object of rich applications. An important property connecting the two binary operations $+$ and \cdot is distributivity, for all rational numbers q, r, s :

$$D. q \cdot (r + s) = q \cdot r + q \cdot s.$$

In fact, distributivity accounts for the otherwise unpleasant fact

1 For every n in \mathbb{N} greater than 1, the number $q_1 + \frac{q_2 - q_1}{n}$ lies strictly between q_1 and q_2 .

that we have to remove 0 to state that \mathbb{Q} behaves as a group relative to multiplication. In general, if a structure similar to \mathbb{Q} satisfies distributivity, it must exclude 0 from the axiom G3 relative to multiplication (the reason being that 0 is the neutral element relative to addition, which makes it special with regard to multiplication in the presence of distributivity axiom D).

REAL NUMBERS

The structural motivations for extending \mathbb{N} to \mathbb{Z} and finally to \mathbb{Q} were *algebraical* in that they concerned some desired properties of the algebraical operations of addition and multiplication. But as indicated at the end of previous section, this leaves out the notion of the length of a line, or more generally of continuity of the line.

Given a right-angle triangle with sides of length 1, what is the length of the hypotenuse? The Pythagorean theorem says that the length l of the hypotenuse must satisfy $l^2 = 2$. Now, is there a rational number $q = \frac{m}{n}$ such that $(\frac{m}{n})^2 = \frac{m^2}{n^2} = 2$? It came as a great surprise when the ancients discovered¹ that no such rational number can exist.

We give an argument for this. A proof like this must have been known to the ancients.

Theorem 1.1 *There is no rational number q such that $q^2 = 2$.*

Proof. We cannot hope to prove the theorem by dealing with each rational number in turn and convince ourselves that its power to 2 is not 2: there are infinitely many rational numbers, and we have only limited time. We will employ a technique known as *a proof by contradiction*, or *reductio ad absurdum*. We will assume that there exists a rational number $\frac{m}{n}$ such that $(\frac{m}{n})^2 = 2$ and will derive a chain of statements based on the existence of this hypothetical rational number which will end with some obviously contradictory statement. This will mean that no such rational number can exist after all.

Assume for contradiction that $\frac{m}{n}$ for $m, n > 0$ is a rational number such that $(\frac{m}{n})^2 = 2$. Then $m^2 = 2n^2$ and so m^2 and also m must be even, i.e. $m = 2k_1$ for some k_1 . It follows that $m^2 = 2n^2 = 4(k_1)^2$, where $0 < k_1 < n$. By canceling 2, we obtain $n^2 = 2(k_1)^2$. Repeating the same argument, we obtain $0 < k_2 < k_1 < n$ such that $(k_1)^2 = 2(k_2)^2$. By induction we construct a strictly decreasing infinite sequence of positive natural numbers $n > k_1 > k_2 \dots$. However, this is the obvious contradiction because there can be no infinite decreasing sequence of natural numbers (there are only n many numbers below n , so no infinite decreasing sequence can fit in there).

Though not present in \mathbb{Q} , we wish to have a number which represents the length of the hypotenuse of the right-angle triangle

It might seem that with \mathbb{Q} we have already added all the numbers which we wish to have to be able to calculate with quantities (elements of \mathbb{N}), debts (negative numbers), and ratios (rational numbers).

But already in the ancient Greece, number-like objects were discovered which are not present in \mathbb{Q} . These concern the notion of a length of a line, or more generally of geometrical objects, such as a circle.

with sides 1. We denote this number as $\sqrt{2}$. Note that $\sqrt{2}$ can also be described algebraically: it is the solution of the so called *polynomial equation*, that $\sqrt{2}$ is the solution of the equation $x^2 - 2 = 0$.

However, again already in ancient times, another number-like object was used, which as it turned out, is not only outside \mathbb{Q} , but is not a solution of any polynomial. This is the number π , which gives the ratio of a circumference of a circle relative to its diameter.²

The concepts governing the behaviour of lines, either straight or given by a circle (and other derived notions), are dubbed *analytical*. Thus the motivations for extending \mathbb{Q} to the real numbers \mathbb{R} are called analytical.

We will not give a precise definition of the real numbers because it is rather technical, but we will give a description of how we can write all the real numbers in the interval $[0, 1]$ using an infinite decimal expansion system. Note that this gives a representation of every real number because every real number is of the form $z+r$, where z is an integer and r is a real number in the interval $[0, 1]$. We will use this description of real numbers in the arguments concerning the size of real numbers, see Theorem 2.6.

We say that r is a real number in the interval $[0, 1]$ if it can be written as an infinite sequence $0, r_0, r_1, r_2, \dots$ where each r_i is either 0, or 1, or \dots , 9. For instance $\frac{1}{3} = 0, 3333 \dots$, $\frac{1}{2} = 0, 5000 \dots$. Since $\frac{1}{3}$ and $\frac{1}{2}$ are rational numbers, their decimal expansions are regular. An irrational number has no such regular pattern. This means that by writing it down, we can only give a finite approximation of it. However, we assume here that such an infinite decimal expansion can be written at least in principle, thus determining the irrational number in question.³

¹ The discovery is attributed to Pythagoras, a Greek philosopher from the 6-th century B.C.

² A real number which is not rational, is called *irrational*. A number which is irrational, and a root (solution) of a polynomial equation, is called an *algebraical irrational number*. Thus $\sqrt{2}$ is an algebraical irrational number. A number which is irrational, but not a root, is called *transcendental*. The existence of *transcendental* numbers follows rather easily by general properties of infinite sets. However such general arguments do not give any information about specific numbers: so the fact that π , and also e , the Euler constant, are transcendental was a great discovery of the 18th century. Realise that to argue that π is transcendental, we must somehow show that there exists no polynomial equation with root π , and this is hard..

³ This refers back the the concept of actual vs.potential infinity of \mathbb{N} .

We denote as \mathbb{R} the collection of all real numbers of the form $z + r$, where z is in \mathbb{Z} and r is in the interval $[0, 1]$. For instance $\pi = 3 + r$ for some such r .

It is apparent that the extension to \mathbb{R} is far more technical, and consequently less transparent, than the extensions to \mathbb{Z} and \mathbb{Q} . The main reason for the difficulty—in our simplified presentation—lies in the notion of the infinite decimal expansion, which seems underdefined.⁴ However, we do need the number π and other numbers like this for the mathematical analysis, so it cannot be a reason for rejecting the real numbers. Rather, we need to try to get as much information as possible about the real numbers, thus understanding them better.

A fairly basic question is the following: “how many real numbers there are?” In preparation for answering this question, we have to first say how we propose to compare sizes of infinite families of numbers.

Remark 1.2 Notice that every real number which ends with an infinite number of 0’s has two possible ways of writing. For instance $0, 50000 \dots$ is the same number as $0, 49999 \dots$. Why? Assume $r_1 = 0, 50000 \dots$ were bigger than $r_2 = 0, 49999 \dots$, then there would be another number r_3 such that $r_1 < r_3 < r_2$ (between any two real

numbers $r < s$ there is another real, in fact rational number). But this would mean that there is some position n such that r_3 and r_1 have the same number on the positions less than n , but the number on the n -th position of r_3 is bigger than the number on the n -th position of r_1 . But this is impossible because this number must be 9, and this is the greatest number which can occur in the decimal expansion. We will make the convention that we will regard $0, 50000 \dots$ (and similar) as the correct expansion, while the expansion $0, 49999 \dots$ will be considered invalid. (This is similar to saying that we use the fraction $\frac{1}{2}$, and not $\frac{2}{4}$, as the preferred representation of the ratio $1 : 2$.)

Remark 1.3 We will not discuss here in detail the *complex numbers*, \mathbb{C} . The reason is that no new concept is being used in their definition: the motivation is algebraical in the sense that we wish to have roots to every polynomial. For instance $x^2 + 1 = 0$ is a polynomial which has not solution in \mathbb{R} . Similarly as we introduced the real number $\sqrt{2}$ for the polynomial $x^2 - 2 = 0$, we introduce now a number which will be the solution for the polynomial $x^2 + 1 = 0$. It is denoted as i (i from an ideal number) so that $i^2 + 1 = 0$. The collection of all these numbers can be represented as a two-dimensional real plane. It follows that a complex number is of the form (r_1, r_2) , where r_1 and r_2 are in \mathbb{R} . See the last paragraph before Section 3 where the size of \mathbb{C} is shortly discussed.

⁴ The official definitions of \mathbb{R} , either by Dedekind cuts, or Cauchy sequences, are also afflicted with similar difficulties.

Comparing sizes of infinite sets

Are there more integers than natural numbers? One should be careful in answering similar questions concerning infinite sets. The first answer (the “naive one”) which comes to mind is YES: there are definitely more integers than natural numbers because integers contain all the natural numbers, and in addition all the negative numbers. And what about the rational numbers? There seems to be even more rational numbers than integers.

In order to decide whether this “naive answer” is a good candidate for comparing sizes, we analyze the situation a little more closely. First realise that there are some criteria which our definition of sizes should satisfy:

- › It should give the correct answer when applied to finite sets. I.e. no matter how we decide to compare infinite sets, this procedure should be general enough to apply to finite sets as well and moreover should give the correct answer for finite sets.
- › It should provide a useful structural framework for more complex concepts involving infinite sets. (This is a more complicated criterion and one which only comes with mathematical practice.)

In discussing sizes of infinite objects we first make convention that we will refer to infinite objects as *infinite sets*. In the mathematical language we write the fact a set B is contained in another set A as

$$B \subseteq A,$$

and say that all elements of B are included in A . Note that the notation $B \subseteq A$ allows the possibility that $A = B$, i.e. that A and B denote the same set.

With this notation, we can write:

$$\mathbb{N} \subseteq \mathbb{Z} \subseteq \mathbb{Q} \subseteq \mathbb{R}.$$

Following our first intuition that the set of natural numbers is strictly smaller than the set of integers, we will formulate the first, “naive definition” for comparing sizes of infinite sets. This definition will turn out to be a wrong one.

Definition 2.1 (Naive definition) *In this naive approach, we use the relation of “being included”, \subseteq , as a candidate for comparing sizes. So we say that a set B is smaller or equal to a set A if $B \subseteq A$. We say that it is strictly smaller if $B \subseteq A$ and A contains some elements which are not in B (we write this as $B \subsetneq A$). We say that two sets A, B are comparable as regards their size if $A \subseteq B$ or $B \subseteq A$.*

So we have

$$\mathbb{N} \subsetneq \mathbb{Z} \subsetneq \mathbb{Q} \subsetneq \mathbb{R}.$$

So far, it seems that the relation \subsetneq is a good candidate for comparing sizes because it yields that \mathbb{N} is strictly smaller than \mathbb{Z} , which is in turn strictly smaller than \mathbb{Q} , etc.

But here is the problem with the definition. We demand that any two sets are comparable as regards their size – this condition is true with finite sets, so we demand it for infinite sets as well. Is it true for our naive definition? Consider the two following sets: $A = \{1\}$ and $B = \{2\}$, i.e. A contains just the number 1 and B contains just the number 2. Is it the case that $A \subseteq B$ or $B \subseteq A$?

No! With the naive definition, we cannot compare sizes of A and B . A similar example, involving infinite sets this time, is the following: $A' = \mathbb{N} - \{1\}$ and $B' = \mathbb{N} - \{2\}$ (A' is the set of all natural numbers except the number 1 and B' contains all natural numbers except the number 2). As before, we cannot compare the sizes of these sets because neither $A' \subseteq B'$ or $B' \subseteq A'$ is true.

We feel, however, that the correct answer should be that A, B and A', B' are comparable, and that they have the same size. Why? Because although A and B contain a different element it is just one: for the purposes of comparing sizes it is important that the elements in A correspond to the elements in B . Similarly, we should say that A' and B' have the same sizes because they both have the same elements when we put into correspondence 1 and 2.

This leads to the following improved definition of comparing sizes:

Definition 2.2 (Correct definition) We say that sets A and B have the same size if we can put into correspondence the elements in A with elements in B . We write this as $|A| = |B|$.

The formal way to express the property that elements of A correspond to elements in B uses the notion of a function. A function F from a set A into a set B , in symbols $F : A \rightarrow B$, assigns to each element a in A and element in B , which we denote as $F(a)$.

NATURAL NUMBERS AND INTEGERS

Now comes the surprise.

Theorem 2.4 According to the improved Definition 2.2, the sets \mathbb{N} and \mathbb{Z} have the same size, i.e.

$$|\mathbb{N}| = |\mathbb{Z}|.$$

Before we give an argument (“proof”) of the theorem, we should shortly analyze its meaning. If we subscribe to Definition 2.2, then we must take Theorem 2.4 as true. If we do not believe Theorem 2.4, we must refuse Definition 2.2. As argued above, the naive definition using the relation \subseteq is simply not correct either. So we would need to try to find yet another definition. Definition 2.2 was first formulated more than one hundred years ago by the founder of mathematics of infinite sets (*set theory*), the German mathematician G. Cantor (1845–1918).

So far, no better definition has been found. Moreover, when one overcomes the initial surprise at Theorem 2.4 (and similar theorems), he or she will start to appreciate its usefulness.

What is important for F to be a function is that it assigns to each a exactly one element in B . However, it can happen that two different elements $a' \neq a''$ in A are assigned the same element in B , i.e. $a' \neq a''$ but $F(a') = F(a'')$. If this cannot happen, that is if $a' \neq a''$ always implies $F(a') \neq F(a'')$, then we say that F is a 1-1 function. Finally, if all elements of B are obtained as values of F , i.e. if for every b in B there is some a in A such that $F(a) = b$, then we say that F is onto (we say that the range of F is equal to B to express shortly that F is onto).

Here are some examples:

- › A function $F : \mathbb{N} \rightarrow \mathbb{N}$ which assigns to each number n in \mathbb{N} the greatest even number less or equal to n is a function, but not 1-1. Indeed, for instance $F(4) = F(5) = 4$.
- › A function $F : \mathbb{N} \rightarrow \mathbb{N}$ which assigns to each number n in \mathbb{N} the number $2n$ is 1-1, but not onto. Indeed no odd number is in the range of F .

Definition 2.3 A function $F : A \rightarrow B$ is called a bijection if it is 1-1 and onto.

The notion of bijection is the correct mathematical formulation of correspondence. Thus the precise way to state Definition 2.2 is that $|A| = |B|$ if there is a bijection from A onto B .

First notice that Definition 2.2 works correctly for finite sets: let for instance $A = \{1, 2, 3\}$ and $B = \{3, 4, 5\}$. Then F which assigns $F(1) = 3, F(2) = 4$ and $F(3) = 5$ is a bijection and so $|A| = |B|$. Similarly for the sets A' and B' defined above: $F : A' \rightarrow B'$ defined by $F(n) = n$ for every natural number in A' different from 2, and $F(2) = 1$, is a bijection, and so $|A'| = |B'|$.

Proof of Theorem 2.4. Define $F : \mathbb{N} \rightarrow \mathbb{Z}$ as follows: $F(0) = 0, F(1) = 1, F(2) = -1, F(3) = 2, F(4) = -2$, and so in. In general:

$$F(0) = 0, F(2k) = -k \text{ and } F(2k - 1) = k$$

where k is a natural number > 0 .

It is immediate from the definition that F is a bijection.

That is $|\mathbb{N}| = |\mathbb{Z}|$. This ends the proof.

As an exercise, one can show similarly that:

- › Even natural numbers have the same size as all natural numbers.
- › If we remove a finite number of natural numbers, the resulting set has the same size as the set of all natural numbers. For instance if we remove first 10^{81} natural numbers, the resulting set still has the same size as the set of all natural numbers.¹

¹ The number 10^{81} is the higher estimate on the number of atoms in the observable universe.

RATIONAL NUMBERS

We made our peace with $|\mathbb{N}| = |\mathbb{Z}|$, but we can at least expect that the size of rational numbers will be bigger. After all, as we have mentioned above, between any two different rational numbers there are infinitely many other rational numbers. But infinity may be misleading:

Theorem 2.5 *According to the improved Definition 2.2, the sets \mathbb{N} and \mathbb{Q} have the same size, i.e.*

$$|\mathbb{N}| = |\mathbb{Q}|.$$

Proof. This proof is a bit more complicated, but only just. For simplicity, we show that the positive rational numbers (including 0), which we will denote as \mathbb{Q}^+ , have the same size as \mathbb{N} . At the end we will suggest how to extend this result to all of \mathbb{Q} .

Recall:

(*) Each positive rational number can be written as $\frac{m}{n}$ where $m \geq 0$ and $n > 0$, where m and n have no common divisor (for instance $\frac{1}{2}$ is of this type, $\frac{2}{4}$ is not of this type, although they represent the same number). We also demand that if $m = 0$, then $n = 1$ (so 0 is uniquely represented by $\frac{0}{1}$).

Imagine now an infinite chessboard whose fields are labeled by pairs (m, n) of natural numbers. In the left lower corner, we have the field $(0, 0)$, above $(0, 0)$ there is $(0, 1)$, next to $(0, 0)$ there is $(1, 0)$, and diagonally above $(0, 0)$ there is $(1, 1)$, etc. Now realise that we can describe an infinite path on this chessboard which will visit each field exactly once, and will eventually visit all the fields.

THE REAL NUMBERS

At this juncture, one might start losing faith and conjecture that even the size of real numbers is the same as the size of the natural numbers. But luckily, this is not the case. The reason for this is the construction of \mathbb{R} which is of another kind: we said that it is *analytical*, in comparison to *algebraical* constructions of \mathbb{Z} and \mathbb{Q} . Indeed if we have managed to prove that $|\mathbb{N}| = |\mathbb{R}|$ it would be a strong structural reason for *discarding* our definition of comparing sizes as ill-defined!

We will show:

Theorem 2.6 *There are fewer natural numbers than the real numbers, i.e.*

$$|\mathbb{N}| < |\mathbb{R}|.$$

Moreover, the path to each fixed field (m, n) will be finite. The path starts as follows (there are many more paths like this, we choose one): $(0, 0) \rightarrow (0, 1) \rightarrow (1, 0) \rightarrow (1, 1) \rightarrow (0, 2) \rightarrow (1, 2) \rightarrow (2, 0) \rightarrow (2, 1) \rightarrow (2, 2) \rightarrow \dots$. We could give a precise definition of the path, but the intuition is clear – in the zig-zag and diagonal way the path will visit each field. As a small exercise, convince yourself that for each n in \mathbb{N} , the path to (n, n) has length $(n+1)^2$ (the number of fields in the rectangle with sides $\{0, \dots, n\}$). But this is enough to construct a bijection between \mathbb{N} and \mathbb{Q}^+ ! Walk on the path and successively label the the pairs (m, n) as follows: whenever (m, n) represents a rational number according to (*) above, assign the next natural number to it. Thus $(0, 0)$ gets nothing because it does not satisfy (*), $(0, 1)$ gets 0, $(1, 0)$ nothing, $(1, 1)$ gets 1, $(0, 2)$ gets nothing, $(1, 2)$ gets 2, $(2, 0)$ nothing, $(2, 1)$ gets 3, etc. By (*) we will eventually label by this process all the rational numbers. Notice that this labeling is the desired bijection from \mathbb{N} onto \mathbb{Q}^+ , which shows $|\mathbb{N}| = |\mathbb{Q}^+|$.

Now we will give a hint as to the fact there is the same number of all the rational numbers as of the positive rational numbers. Each negative rational number is represented as $-\frac{m}{n} = \frac{-m}{n}$ for m, n as in (*) above (where $m > 0$). So imagine that the infinite chessboard we used above has the additional property that each field is subdivided into two fields: instead of one field (m, n) we have a field with two subfields $(m, n)_0, (m, n)_1$. We interpret the field $(m, n)_0$ as (m, n) and the field $(m, n)_1$ as $(-m, n)$. When constructing the path above, just visit each field two times. This gives a bijection between \mathbb{N} and \mathbb{Q} , and so also a bijection between \mathbb{Q}^+ and \mathbb{Q} .

Proof. We should not be confused into thinking that it is immediately obvious that $|\mathbb{N}| = |\mathbb{R}|$ is false. We might first try to construct a bijection between \mathbb{N} and \mathbb{R} , in an attempt to find a similar construction as the one given above in Theorem 2.4 or 2.5. After some time, if all such efforts failed, we might start to wonder whether it is possible to find such a bijection.

But how could we prove that there exists no such bijection? Clearly, as with the proof that no rational number is equal to $\sqrt{2}$ (see Theorem 1.1), it is not possible to list all functions from \mathbb{N} to \mathbb{R} and check whether there are bijections or not. We will again use the *proof by contradiction*, or *reductio ad absurdum*. We will assume that there exists a bijection $F : \mathbb{N} \rightarrow \mathbb{R}$ and will derive a chain of statements based on the existence of this hypothetical F which will end with some obviously contradictory statement.

So assume that $F : \mathbb{N} \rightarrow \mathbb{R}$ is a bijection. First realise that it means that all the real numbers can be put into a table with \mathbb{N} -many rows and \mathbb{N} -many columns. Indeed because we assume F is onto, each real number r has some m in \mathbb{N} such that $F(m)=r$. We will

1 Mathematics attempts to classify and structure objects into useful categories so that they can be studied properly. If all sets had the same size, the notion of size would be useless.

say that r is written in the m -th row of the table. Using the infinite decimal representation, the number r is then written up into the columns indexed by natural numbers (a number $0, 4321 \dots$ is written as $4321 \dots$). Accordingly, for every m, n in \mathbb{N} , the field (m, n) in the table contains the number between 0–9 which occurs in the real number in the m -th row of the table on the n -th position of its decimal expansion. Let us denote this table as T .

Now define the following procedure: modify the table T by changing the numbers on the diagonal of the table by adding +1 to each of the numbers if they are less than 8, or change them to 0 otherwise (so that 0 becomes 1, 1 becomes 2, etc., but 8 becomes 0 and 9 becomes 0). We will abuse the notation and refer to this operation as “+1”. Note that this operation never yields the number 9; this is to avoid a forbidden representation composed of all 9’s, as stated in Remark 1.2.

Let us denote this new number in the field (m, m) as x_m . Now look at the number t whose decimal expansion is given by the diagonal in the new table:

$$t = 0, x_0, x_1, x_2, \dots$$

It is an infinite sequence of natural numbers, so according to our definition it represents some real number.

Crucially, since we assume that the table T lists all the real numbers, it must contain the number t as well. So let k be the natural number such that t is written in the k -th row of the table T .

We now claim that this is impossible. Look at the field (k, k) in the table T . The number on the k -th position of t is x_k , but also due

to the construction of t , it must be the number $x_k + 1$ (recall that x_k is obtained from the field (k, k) by adding +1)! So we reached the contradiction that the number t has both the number x_k and $x_k + 1$ on its k -th position.

We conclude that no such table T can ever be constructed, which means that there can be no bijection between \mathbb{N} and \mathbb{R} , and so $|\mathbb{N}| < |\mathbb{R}|$.

Remark 2.7 We can phrase the argument above also in a more positive way: given any listing of the real numbers in a table such as T , there always exists a real number which is not included in the table.

Before we address the question what are the infinite numbers, let us state (without proof) some other results:

- › Let \mathbb{R}^2 denote the Cartesian plane (a 2-dimensional space). Then $|\mathbb{R}| = |\mathbb{R}^2|$, so there is the same number of real numbers as the points in the 2-dimensional plane. So in particular, complex numbers \mathbb{C} have the same size as the real numbers \mathbb{R} .
- › For each n in \mathbb{N} let \mathbb{R}^n denote the n -dimensional space. Then $|\mathbb{R}| = |\mathbb{R}^n|$.
- › Let $\mathbb{R}^{\mathbb{N}}$ denote the infinitely dimensional space. Then $|\mathbb{R}^{\mathbb{N}}| = |\mathbb{R}|$.
- › Let $\mathbb{R}^{\mathbb{R}}$ denote the space of all functions from \mathbb{R} to \mathbb{R} , then $|\mathbb{R}| < |\mathbb{R}^{\mathbb{R}}|$.

So there are bigger and bigger sets because we can always take the set of all functions from the given set to the same set, and it will always be bigger.

Infinite numbers

THE ALEPS

An attentive reader must have noticed that we have so far only compared sizes of infinite sets, but did not assign any “number” to them, i.e. we did not say how big these sets are. In dealing with finite sets, we not only say that a finite set A has more elements than another set B , but we can also measure this amount by giving the exact number of elements each set has.

With infinite sets, we first need to define what such infinite numbers are, and then we need to assign them to the common sets (such as natural numbers, integers, rational numbers, real numbers, etc.). So far, the arguments that

$$|\mathbb{N}| = |\mathbb{Z}| = |\mathbb{Q}| < |\mathbb{R}|$$

might seem unusual because they deal with infinite sets, but the arguments themselves are rather straightforward. Indeed, if one gets used to the concept of comparing sizes via bijections, these arguments are easy. So we should start with a warning that while it is relatively simple to define what infinite numbers are,¹ it is more complicated to assign a certain number to some well-known sets, such as \mathbb{R} .

We demand of these infinite numbers two things:

(*) if a set X is strictly smaller than a set Y , then the number assigned to X should be strictly smaller than the number assigned to Y .

(**) Conversely, if X and Y have the same size, they should be assigned the same number.

We start our definition of infinite numbers with \aleph : it is the smallest infinite set in the sense that any element n of \aleph is finite, but \aleph itself is not finite. Or put otherwise, there is no infinite set X which is strictly smaller than \aleph , i.e. no infinite set X such that $|X| < |\aleph|$.

Definition 3.1 We denote the number of elements in \aleph by the symbol \aleph_0 (“aleph zero”). Accordingly, \aleph_0 is the least infinite number:

$$0 < 1 < 2 < \dots < n < \dots < \aleph_0$$

It follows by (**) above, in connection with Theorems 2.4 and 2.5, that the number of integers and of rational numbers is also \aleph_0 . Now, we know that \aleph is strictly smaller than \mathbb{R} , so whatever

¹ But we will not do it here since it does require some technical definitions.

number we assign to \mathbb{R} , it should be bigger than \aleph_0 . It is tempting to define the size of \mathbb{R} as the next larger infinite number \aleph_1 .²

$$0 < 1 < 2 < \dots < n < \dots < \aleph_0 < \aleph_1.$$

Let us examine what it means if we say that size of \mathbb{R} is the next infinite number, \aleph_1 . This means that there can be no infinite set X such that $|\mathbb{N}| < |X| < |\mathbb{R}|$ because in this case, using (*) above, should \mathbb{R} be assigned at least the number \aleph_2 (and X might get \aleph_1).³

² \aleph 's are called cardinal numbers and they can be rigorously defined using set theory.

³ Similarly, if there were two sets X, Y such that $|\mathbb{N}| < |X| < |Y| < |\mathbb{R}|$, then \mathbb{R} should get at least the number \aleph_3 , and so on.

THE STORY OF CH

The first attempt, and indeed the formulation of the problem, is due to G. Cantor. He had made some progress because he managed to show for quite a broad type of infinite sets that no set X from this class satisfies $|\mathbb{N}| < |X| < |\mathbb{R}|$. This assured him in his conviction that his results will extend to include all sets X , thus proving CH.

However, after more than 30 years, no such general proof was found. After such a long time with no proof found, a weaker result achieved by an Austrian mathematician K. Gödel (1906–1978) was greeted as a real break-through. In order to formulate the result of K. Gödel, we must shortly discuss one of the major developments in mathematics related to the notion of mathematical logic and of the predicate calculus. This topic concerns the understanding of the limits of formal reasoning in mathematics (and elsewhere). In principle, every mathematical argument can be viewed as a finite list of statements which has a very simple structure. Included in the list are some basic statements, called *axioms*, which we take for granted as obviously true, but the other statements must follow from the rest of the statements by some predetermined rules. The whole framework for such formal reasoning is called the *first-order predicate* calculus. The main benefit of such rigorous definition of an argument is that it is then possible to examine this formal system by mathematical means. Indeed, while it may be impossible to decide whether some statement σ is true (whatever this means), it may be possible to decide whether there is a formal argument which derives this statement. This is because there are no rigorous criteria as to what it means to be true in general, while there are exact criteria as to what a formal argument is like.

Now, K. Gödel managed to show in early 1930's that no formal proof of the negation of CH (denoted as \neg CH) can ever exist from the accepted axioms of set theory! In other words, it *may be the case* that CH is provable. As we suggested above, this is weaker than proving CH, but it still gives a new piece of information: CH may

$$0 < 1 < 2 < \dots < n < \dots < \aleph_0 < \aleph_1 < \aleph_2.$$

Definition 3.2 *The hypothesis that there is no infinite X such that $|\mathbb{N}| < |X| < |\mathbb{R}|$ is called the Continuum Hypothesis, CH. It is also written as*

$$2^{\aleph_0} = \aleph_1,$$

where 2^{\aleph_0} denotes the size of \mathbb{R} .

CH was first conjectured to be true by G. Cantor and was made famous by D. Hilbert (1862–1943), a distinguished German mathematician, who included it in his list of problems for the 20-th century. So is CH true or false?

be provable, but \neg CH definitely cannot be proved. This reassured those who believed that CH holds.

Naively, one would say that the result of K. Gödel already means that CH is provable, and what remains to do is to find the proof. This naive standpoint rests on the assumption that either CH or \neg CH is provable (this is true for truth, intuitively, so it should hold for proof as well). But here is the surprise, again it was K. Gödel who showed, in early 1930's, that for any sufficiently strong and nicely formulated system of axioms, there is a statement σ which is *independent*, i.e. neither σ , or $\neg\sigma$ is provable. The accepted axioms of set theory are sufficiently strong and nicely formulated, so this result applies.

Can it be the case that CH itself is such a statement which is independent? It took the mathematicians another 30 years to settle the question: in 1962, P. Cohen (1934–2007), a bright American mathematician, showed that there is no formal argument for CH. In other words, it is not possible to prove CH. Combined with the earlier result by K. Gödel, this means that we cannot prove from the accepted axioms neither CH, or \neg CH.

How should we interpret this result? Some people say that this means that CH is neither true or false. But this view is most definitely incorrect. As we hinted above, the correct interpretation is that there is no formal argument which proceeds from a given list of axioms and ends with CH or the negation of CH. So we had better say first what these axioms are, and then proceed to claim that they are not sufficiently rich to decide CH one way or the other. In this formulation, the lack of proof for CH or the negation of CH does not sound so counterintuitive after all. A minor drawback is that these axioms, called the *Zermelo-Fraenkel set theory with Axiom of Choice*, ZFC (see the Appendix), are very powerful and at first no one could envisage a strengthening of ZFC which would decide CH.

AS A CONCLUSION

From the basic facts about numbers, we have reached the point where a deeper understanding of concepts of infinite sets is required. In order to answer such a simple question as “how big are the real numbers”, we need to develop a whole new branch of mathematics, called the *set theory*, which deals with infinite sets. The basics of set

theory will be taken up in the projected second part of the paper, where ZFC and CH will be discussed with more details.

For now, we must conclude on a pessimistic note by saying that based on the axioms ZFC, there is no way how to determine whether the size of \mathbb{R} is $\aleph_1, \aleph_2, \dots, \aleph_n$, or something even bigger.

An appendix: the axioms of set theory

Without being too formal, here are the basic axioms of set theory. In their more formal form, as given by the first-order predicate calculus, they are called the *Zermelo-Fraenkel set theory with the Axiom of Choice, ZFC*.

For better orientation we may divide the axioms into two groups: (i) *structural properties*, and (ii) *algebraic properties*.

(i) Structural properties.

- › *Extensionality*. Two sets are identical if and only if they have the same elements.
- › *Infinity*. The natural numbers, taken all together, are a set. In set theory, this set is customarily denoted as ω . (We have denoted the same set \mathbb{N} in our article.)
- › *Axiom of Foundation*. This is a statement which prohibits the existence of some strange and useless sets. For instance it claims that there is no set x which is its own element.

(ii) Algebraic properties.

- › *Pairing*. For any two sets x, y there is another set $\{x, y\}$ that contains exactly the sets x, y .
- › *Union*. For any set x there is another set $\bigcup x$ that contains all elements of all the elements of x (i.e. y is in $\bigcup x$ if and only if there is another set z in x , and y is in z).

Comment. This operation has an obvious connection with the \cup operation known from the basic (school-taught) set theory:

$$\bigcup\{x, y\} = x \cup y.$$

\bigcup is obviously more general – unlike the \cup operation which joins elements from *two* sets, \bigcup can join the elements of arbitrarily many sets (their number is determined by the size of x in $\bigcup x$).

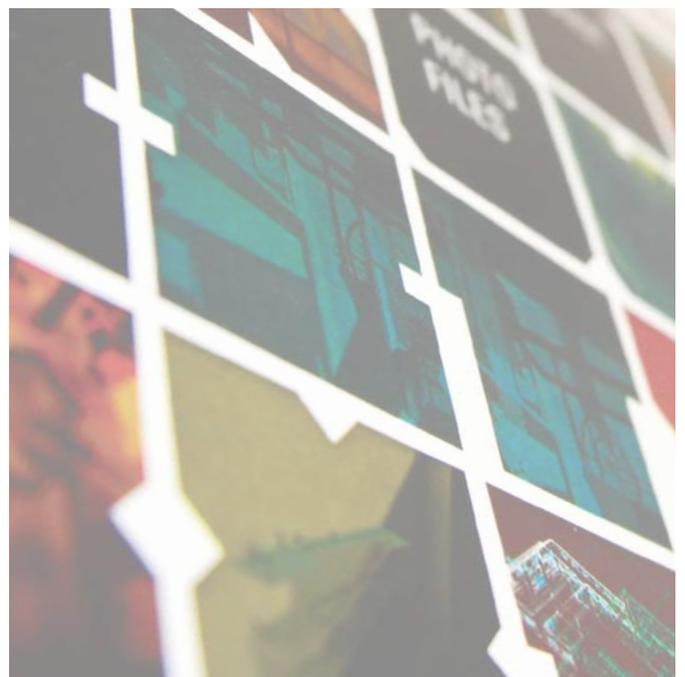
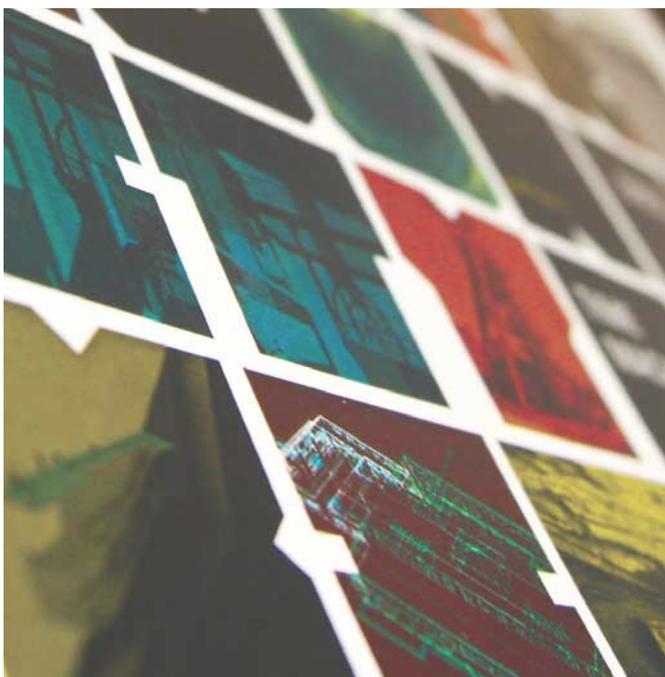
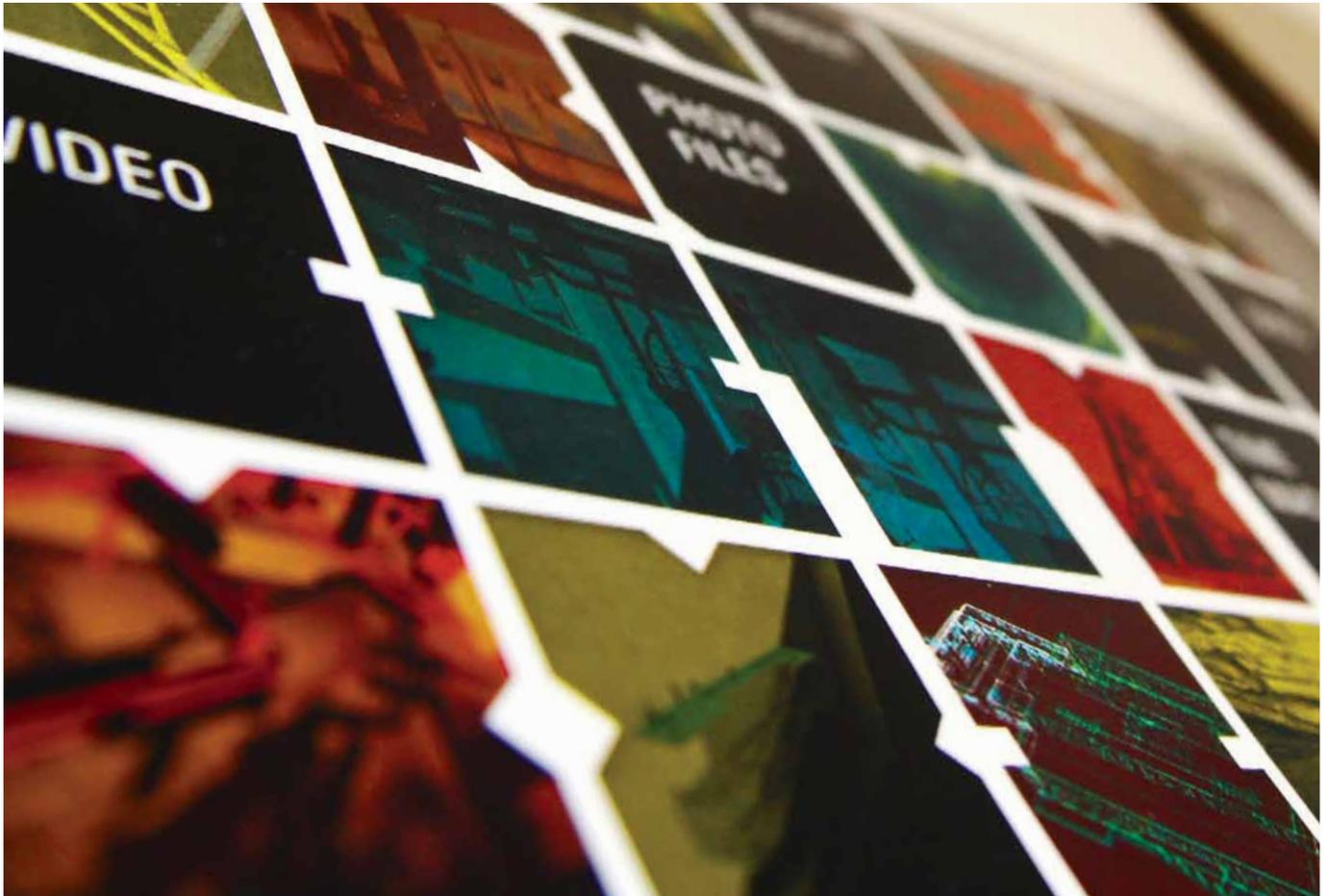
- › *Power set*. For any set x there is another set $P(x)$ which contains exactly all the subsets of x .
- › *Closure under arbitrary set-operations*. For any operation F from sets to sets, the range of F restricted to any set x is also a set.
- › *Axiom of Choice, AC*. For every set x there exists a choice function on x , i.e. a function F whose domain contains all non-empty elements of x and for each such y in x , the value $F(y)$ is in y .

The theory ZFC is sufficiently strong to develop all the current mathematics: number theory, real and complex analysis, functional analysis, theoretical informatics, etc. As stated above, it is not strong enough to decide whether CH or \neg CH is provable.

Radek Honzik (Charles University, Department of Logic)

Part III:

School of Art and Design



#City Branding: can a graphic identity fully represent a city?

Introduction

The aim of this paper is to explore the subject of city branding focusing mainly on the graphic aspects of such brands and how well they can represent cities. It will first concentrate on how and why did the idea and practice of city branding emerge, and what are the aims and methods behind this practice. This will be followed by a case study to provide more insightful analysis of the ways city identities communicate and how well do they manage to reach different audiences; identification of factors and aspects which do or do not contribute to a successful representation of a city through a visual identity it is given. Finally more examples and approaches worldwide will be analyzed briefly, and common successes/failures will be identified.

The investigation is based on a range of sources including books and articles on modern tendencies and approaches associated with modern city communities; place and city branding and management; particular examples of city identities supported by the information from their official websites; identities' guidelines and public opinion

presented in blogs. It will include the opinions of several experts in a field of place branding, the positioning of certain identities provided by their creator designers, overview of public responses to the identities and a personal analysis provided by the author.

Throughout the investigation the opinion that a modern city can not be effectively represented by its visual identity will be argued. This will be achieved by considering all of (or in some cases a number from) the following factors: initial approach of the identity creator, facts and common opinions on the particular location, visual characteristics and components of the identity, certain aims discussed in the first part which may be responsible for a limited representation of a city through its visual identity.

It is important to note, that this investigation will aspire to concentrate on the identities, which appear to be more thorough than having a mere ambition of tourist attraction, as those examples tend to be visually dull and would not provide a sufficient room for argument.

Introducing city branding. Historical overview, aims and methods

INTRODUCTION TO THE CHAPTER

Every year cities are becoming larger and more complex. The process of urbanisation has been succeeded by metropolisation and today we have international giants as Tokyo with impressive 33,8 million citizens, New York, with almost 22 million, London with its 12 or Paris with 10 (City Population 2009 [online]), not to mention a number of rapidly growing megapolises in the developing countries. The population of the megapolises is becoming more and more international, the number and diversity of cultures, languages, buildings in one place are astonishing. And considering this, can one simple graphic symbol such as a logo reflect it all? Usually there is also an identity - system of graphic rules connected with the symbol, but still it is hard to imagine these can stand for the range of colours, shapes and moods of a city in any one day.

Nevertheless the trend is currently very popular and cities all over the world are investing in acquisition of a symbol, identity. Seems like in a miscellaneous modern world bringing something complex to a simplest form is the only way to convey a message. But what can cities need to communicate and to whom? Well, there is not one audience, but many target groups, and a number of messages to be passed to each of them.

Although this may seem complex in the first place, it becomes clearer, if we think about general modern trends. It is repeated often, that contemporary world is ruled through visuals, rather than words

(Ewen 1999). Images are the easiest way to communicate and influence public opinion. Through a number of media easily accessible by the majority of the population masses of information are passed every day, and as it is impossible to grasp it all people have to be more cautious in choosing their source of information. Also they no longer need to read a book to learn more about a certain city, when it is possible to visit a website and spend much less time browsing through, or follow the advertisement seen on a billboard or a magazine; it takes a thorough visual design to make those sources look trustworthy. Simple and direct advertisements may be much more successful in evoking interest than a highly informative document, however not without a look of quality and a known origin, which is most commonly represented by an organization or a brand. For quite a long time, no product can succeed on a market without a brand and visual identity behind it. And so it becomes with modern cities.

The simplest way to say it would be: cities need graphic identity, because nowadays it is the best way to make their promotion and communication more effective and convincing. However simple, this explanation provides only a single angle of the situation and brings along a chain of new questions: Why would city need to get attention? Who do they target? Who creates their identities and by what methods? And how successful can these identities be?

CREATIVE CITY

Supposedly it all started in the 1950s, when the University of Chicago, one of the prominent centre for modernization studies at that time focused its attention on cities as instruments of “economic development and cultural change” (Redfield 2008 p.227). After a conference on the previously mentioned topic a number of its participants published their findings, which were introducing some very far-reaching points. They argued that cities might be distinguished as “generative” and “parasitic” (Hoselitz 1954-1955), and in those generative ones; which are in fact main vehicles of change and development; a number of factors may be identified, which foster their generative role. Later in 1980s the Creative City idea appeared, which was a more contemporary and advanced version of Generative City one,

and was later explained in depth by Charles Landry (2000).

The Creative City idea may be seen as the one which explains the core reason for modern branding trend. Landry notes that “in this new global dynamic, all cities, small and large, need to reassess and rethink their role and positioning – regionally, nationally and globally” (2008 p.xvii). Considering the fact, that ideas are most valuable goods of the modern age, cities are urged to devote their policies and planning to stimulating creativity within the local population and attracting new creative-thinkers into the city. And by demonstrating greater creative potential cities will raise investment and get a greater chance to wealth and further development (Landry 2008).

TARGET AUDIENCES OF CITY BRANDING

Larger and diverse – modern cities have greater potential now, but the competition between them gets as great. Not only do cities need to allure tourists and potential citizens, they also have a hard time keeping their current residents (Kavaratzis 2005). Factors such as expansion of urban communities and a large number of newcomers and residents, who are originally foreign, result in general lack of a strong emotional attachment to a city or a bond to the community; it is now common that even living side by side people may not be acquainted. This tendency suggests an important direction in a modern city planning: it should plan new and adjust old territories to encourage more social contact and ideas exchanging, and again, seek the means to identify itself, express its personality and uniqueness to develop a relationship with its citizens.

Experiencing the unique, the different is also what the tourists all over the world seek, and they are another large audience cities are urging to appeal to. People now may have their own impression of a city without ever going there. They receive messages concerning a particular city from news reports, film, literature (Ash-

worth and Kavaratzis 2005 p.507), both facts and opinions. These random messages form a personal notion of a place, which may or may not match an image of it promoted in a branding campaign. Thus, establishing a specific identity may be a greater challenge for cities that tend to appear in the above listed sources more often; while on the other hand the mere fact that the location is famous might provoke curiosity and a will to visit it.

The third combined audience constitutes of potential investors and existing stakeholders. As mentioned above, to get a country, organization or individual invest in a city or develop a business there, the city must demonstrate its potential. Even if a greater potential is still in process of development, but is clearly communicated in planning and strategies, it will make the city more attractive. Considering this last group of targets, the most interesting thing, perhaps, is that a particular identity given to a city might serve as a plan for development and change (Finucan 2002). An identity might represent a manifestation of a direction, a resolution and determine future policies.

WHAT MAKES A CITY UNIQUE?

There may exist as many impressions of a city as there are people who have ever visited it. In detail, each perception is different. There are three general ways of how people perceive places. The first is through the way space in a location is planned – urban landscapes and design; second – how they and others use the location and their own encounters associated with it (Crang 1998). Going further, what makes the cities more or less convenient to use is obviously the level of their management and wealth and their cultural resources. Those make life there richer and experiences more interesting and unique.

Cultural richness includes all that a city acquired through histo-

ry, as well as more recent development. Some of the unique aspects of a city may include typical architectural forms and architectural landmarks, traditions in art, science and social life, famous figures in different disciplines, traditional holidays, festivals, local crafts, cuisine and languages, characteristics of local community and social life and even historical events and mythology associated with the place. Moreover, cities now aim to acquire more characteristics highly appreciated in a modern society, such as eco-awareness.

However it may seem that cultural richness of a place only makes identifying it easier, it is not entirely so. There is a limit of “specific” features or associations that may be addressed in a brand,

not to mention a graphic identity. Putting priority on one of the features may lead to neglecting the other ones, and eventually result in a limited identity. In that way, too many aspects to represent uniqueness are harder to reflect in an entirety, than less.

A limited identity is less problematic if we consider only tourist targeting. Unlike investors, stakeholders or citizens, potential tourists may not have a reality-based notion of a city before they visit it. Moreover, tourists may still not acquire a full impression after visiting, as they are often pre-directed on which particular aspects are most essential and worth seeing. One of the world's

leading experts in place branding, Simon Anholt declares that "it is often the case that the image presented by the tourist industry is irrelevant, unhelpful or even damaging to the country's other ... activities" (2004), and this is certainly also true for cities. Thus, attempts to promote cities only to potential tourists only lead to a series of non-representative examples. However, when the aim is to create a single identity, which would be successful with all target audiences, the effective solution requires much more thinking and effort, and may even be impossible to achieve.

BRANDING STRATEGY

As branding lies in the core of city identification, it is worthy to introduce brand definition and explain some of its objectives. There are many ways to define a brand, as the branding practice has been functioning for years now and the strategy and main values are constantly being modified. For example, according to a definition made by Cowking and Hankinson, "[A] brand is a product or service made distinctive by its positioning relative to the competition and by its personality, which comprises unique combination of functional attributes and symbolic values" (1993 p.10). Hence, there is something more than shaping the physical and functional uniqueness. A brand is also a strategy, values and promises, which "add value" to

a product, service, or city, represented by it; a brand attributes a number of intangible benefits, emotional associations with it. What more, it is essential that the success of a brand also depends on how well the promises are delivered, that is why the branding strategy should be based on real and extensive research and supported by future development of a product or a city. In case of city branding, a campaign begins with broad investigation in city's history its current condition and social perception, performed through social polls in a number of different audiences to find out do people see a particular city and also, how they want to see it, what do they expect; and an defying of assets, problems and potential solutions.

Case study of graphic identities of the New York City and London

INTRODUCTION TO THE CHAPTER

Now that the concepts have been introduced it is time to consider specific examples. Assessing the success of a graphic identity will be more substantial when the initial aims and approaches are understood. The following case study will not only analyse current official graphic identities designed for New York City and London, but consider former examples, the ones, which are to represent one or another city to a specific audience, and, in case of London, the approaches to creating a new identity. The aims of the case study are to determine how well are the cities represented by their identities, considering what are the successes and failures of those, what is the thinking behind the logo and identity, how and how well do they communicate, what are the obstacles on the way to a successful identity and what are the approaches taken to create a new representative identity (in case of London).

Many large and famous cities all over the world lack an official

logo and identity. Cities such as Tokyo, Paris and Moscow do not have a brand, and one of the reasons for it is the complexity of a task such as putting the essence of place into a symbol and colour scheme. There are other reasons, of course, individual to each city. Both New York City and London are global cities, they are great and multicultural, famous and celebrated. They are already known, as for they host world's major cultural fairs, they constantly appear in media and are depicted in literature, film and art. These are the cases, when an identity of a location would rather aim to represent, than advertise, to express, to bond the community together, which is much deeper than mere promotion. On the other hand - smaller cities may be easier to represent in design, but these are often in more need to start promote outside and shape though an identity, rather than trying to characterize the existing.

NEW YORK CITY

What other city can be as miscellaneous as New York City? A city hosting tenth of largest ethnic communities in America, where more than 170 languages are spoken and 36% of the population is

foreign-born. New York City is a city of freedom, opportunity, arts, fashion, design and many more. It is amusing, how many people, who haven't ever been to it, know the skyline of NYC or streets of

Manhattan thanks to American Film industry. New York is an urban giant; its architecture is an embodiment of power and is impressive as well as overwhelming. As depicted by Charles Landry, the graduate transformation of traditional community makes fostering social integration and understanding a leading direction in municipal policies (Landry 2008 p.27). However it is easy to admire such a city, it is hard to feel that you belong there. And perhaps because that is exactly what the 'I love NY' logo, created more than 30 years ago, addresses, it became the most successful place identity ever designed.



Fig. 1 The "I love NY" logo

I LOVE NEW YORK

The 'I love NY' logo was designed in 1975 by Milton Glaser, who did this job pro bono. As the designer admits now, it was meant to represent a temporary campaign for New York State intended to increase social awareness of the citizens as well as attract tourists (The Believer magazine 2003); no one knew it would last for more than three decades. If one tries to analyse the visual characteristics of the logo, they are fairly time and place specific. The heart symbol was among the central ones in popular culture and was widely used by the supporters of social revolutionary movements in 1960s-70s essential to American society of the time. The typeface, ITC American Typewriter recreated in 1974 based on an 1868 typewriter patent by an American Christopher Sholes. It may evoke many associations from bureaucratic forms to famous American writers, who used typewriters for their manuscripts. However, in the case of Milton Glaser's logo, it is the rounded friendliness and the "individual" aspect of the font, which are the most significant. Unlike serifs of the traditional print or sans-serifs of the time's contemporary design, it was slab-serif monospaced typewriter font,



Fig. 2 A poster designed by Milton Glaser after the attack on 9.11 2001

which was available to anyone. A typewriter was a common part of a household, and was a means of self-expression on paper. Summing up the above analysis, what 'I love NY' communicates is an individual voice of each expressing the attachment to his or her city. It reflects the democratic tradition of the American society and then proposes love as social bonding. With time, the logo began synonymous with NYC rather than the state, it became iconic and was used in numerous applications from municipal marketing materials to popular clothing.

It is hard to tell now, whether the logo was the beginning of the positive social shifts in the city's society or a punctual representation of it, but it was so direct that it became an inevitable part of NYC's urban culture. How well does 'I love NY' represent NYC becomes a tricky question at this moment. Although, the logo does not reflect many modern features of the city, it communicates the city's history and is so connected to the city's culture that with time it became an unquestionably appropriate symbol for the city.

NYC BY WOLFF OLLINS

Still, 'I love NY' was meant to be an official logo for the state rather than the city. Thus in 2007, a new brand exclusively for NYC was launched accompanied by a new visual identity by world famous studio Wolff Olins. NYC tourism has in fact increased since 2007, but it is hard to access the overall success of a new logo, because it is still too recent, and can be proven only by time.

Stating their ambition in NYC logo Wolff Olins stress the complexity of the city and its multi-cultural and ethnical aspects. The fact that so many diverse people, events, arts and businesses can exist next to each other is depicted in a logo, where letterforms are squashed together with no space between although each can be filled with a very different colour or content image. More aspects, such as heaviness and geometry of letterforms, which depict the power of the city as well as its massive and geometric skyscrapers and the letters' position on a square based grid, may be associated with the city's regular planning (Brand New 2007 [on-



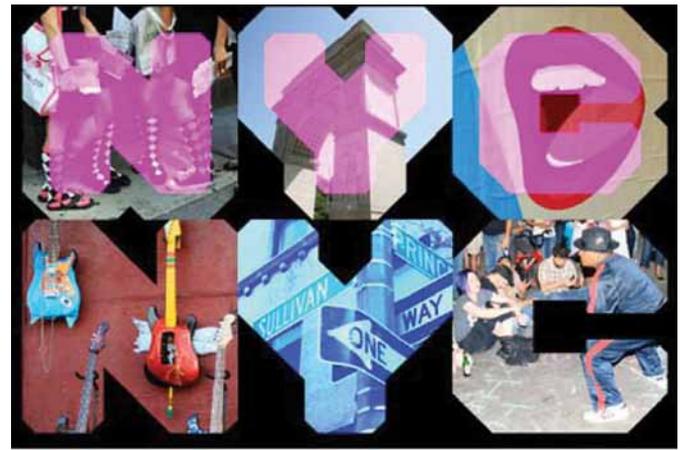
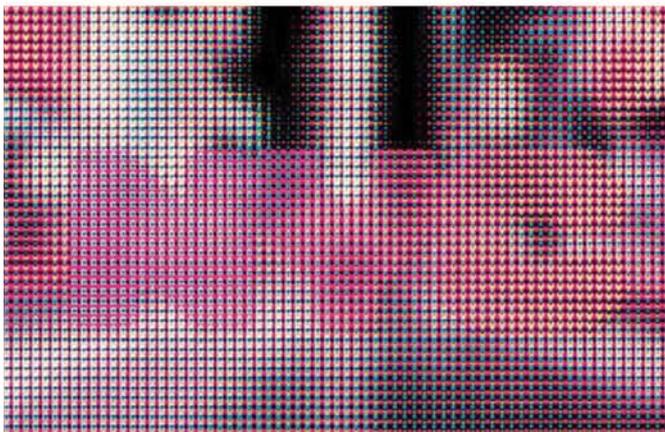
Fig. 3 NYC logo by Wolff Olins



Fig. 4 NYC logo on grid



Fig. 5 NYC logo applications



line)). Though, the logo without a set of corporate message applications would not be as representative. It is its application, which allows to incorporate colour and imagery within the letterforms or combine them together into pattern, which results in a very intense, dynamic and vivid feeling characteristic for NYC itself.

LONDON

London is the only city to compare well with New York City in terms of cultural and ethnical diversification, a dominant global city, one of key financial centers and a key European capital. It has as many dimensions to it as NYC does, and one, which is not that crucial in the case of the latter, which is history and tradition. It has been a dominant city in Europe and the world for centuries throughout history. Modern London combines the heritage of the British Empire's might and more than a thousand years of British tradition with its modern dynamics, architecture and new diversified society. What are commonly recognized features of London? The number of its Monuments of Architecture, used to be learned by school children all over the world: Westminster Abbey, St Paul's Cathedral, Tower Bridge, Big Ben and other, as well as modern architecture as London Eye or Gherkin; associations with British Royalty: Buckingham Palace and the guards; London Underground the first in the world with its iconic design; London parks and its rainy weather; its literary and art tradition and a lot

The presence of such a strong symbol as "I love NY" makes it hard for any new symbol to be accepted by the society and the success of NYC logo is not yet evident. Despite this, the logo is very cleverly designed and possesses symbolic and visual aspects that are associated with and characteristic for the city.

more. As in case of New York all of the richness does not make a graphic designer's task an easy one. That is why, perhaps, London still does not have a unified official logo.



Fig. 6 Think London logo by Johnson Banks

THINK LONDON

Think London is the city's official foreign direct investment agency, established in 1998 to attract foreign businesses to the city. In 2007 a new graphic identity for it was designed by Johnson Banks. The studio approach to a graphic symbol is unusual: "how do you distill all that London has to offer into 1 symbol? Well, you don't. You use 45." (Johnson Banks (no date) [online]) A logo depicts the actual London skyline in a cyan-rich vibrant blue turned upside-down, and it's upright "reflection" made of various symbols for different aspects of London's life including music, parks, football, ballet, science, engineering, film, transport and so on. It is supported by a systematic use of similar style and colour icons for different sections and messages, and is generally a well designed, attractive and dynamic identity. What would not allow it to be a unified image for London is perhaps lack of versatility and insight. It communicates well in terms of its function – to portray London as an incredibly vital and festive city possessing legacy built with years as well as potential in almost any possible discipline, but fails to provide atmosphere or community factor, which would be needed, if it would also be intended for local audience. Moreover, a logo that complicated would be very limiting for a wider use and would not last.

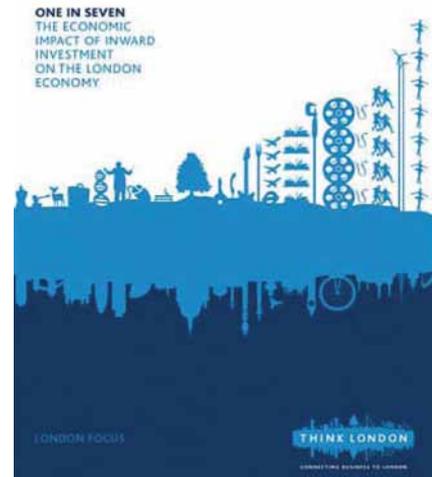


Fig. 7 Think London brochure cover

VISIT LONDON

A logo for Visit London for city's marketing branch dealing with tourism was introduced in 2006. It is a typographic solution, where the story is told mainly by alternate taglines. The logo is depicted in dark red, which is associated with the city thanks to references to British royalty and heraldry (the Cross of St. George) and attractions such as red busses or phone-boxes. The taglines are a set of factoids concerning London, such as "Est. 50AD", "300 languages spoken" or "It rains more in Rome". The factoids are supposed to be witty and catching attention and the main if not only message of them is "London is legendary". This logo, as designed to target tourists, is inappropriate for wider usage, as it is quite limited in its communication and fails to provide a rich corporate message system.



APPROACH TO A NEW IDENTITY

In summer of 2009 the mayor of London announced the tender for an identity to represent a unified London brand ahead of 2012 Olympics. The outlined goals mentioned unity of a brand and stakeholder activity, considering an image a mechanism of promotion as well as internal policy mechanism (A brand for London 2009 [online]). Specifically, a multi-purpose location brand as outlined in Chapter 1 of this paper. The reason why a yet unrealised project is mentioned within this investigation

is a distinctive approach to the task one of the tender-participant design agencies took.

The London branch of international Moving Brands agency based their strategy on urban community involvement. Supported

by successful example of the "I love NY" logo, accepted and appreciated by its community and London 2012 logo, which met negative or controversial public response, the agency claimed that it is community orientation, which is essential; it is how Londoners see their city, which constitutes it. Moving Brands set up a public blog, where they published their work process for social critique and also launched a campaign to encourage Londoners submit their ideas. On the basis of all above analysis, one might find this approach promising, as it is urban community, which may perceive the location's identity the most thoroughly as well as it is a key target group in case of branding of a globally-known city.

Moreover, there is a number of serious obstacles on the way to finding a successfully representative image for London were

addressed in a blog launched by Moving Brands, which can add to already mentioned limitations of modern city identification. First difficulty is again the richness of the city's identity and its infinite characteristics. The second serious hamper to a new symbol is always a strong existing analog. London Underground roundel has become iconic for the city, similarly to Milton Glasser's logo for NYC. However the symbol serves a very different and specific function for the city, it narrates its history. Being a

symbol for world's first Underground system is depicts London as an industrial pioneer and being a first example of a simple but functional design, notably innovative back in early XX century, when it was established, it informs of London's tradition in playing a significant role in world's culture.

Thus an interesting question arises: perhaps searching for a new visual language to successfully depict a city, the designers must rather find an old time-proven symbol and adjust it for modern needs?



Fig. 9 A part of Edward Johnston's drawing of London Underground roundel

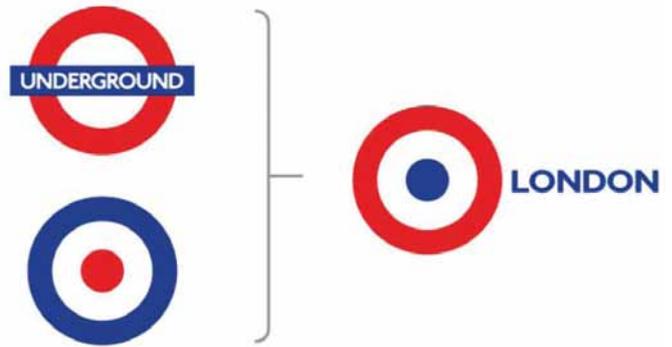


Fig. 10 One of the ideas of the underground roundel modification into a logo for London by Moving Brands

General overview

In this chapter a number of examples of specific city identities will be introduced to bring the investigation to a broader scope and use them to introduce and asses a trend in city branding design.

MODERN TREND: FLEXIBLE IDENTITY



Fig. 11 The main logo of Melbourne and its variations



Fig. 12 The new identity applications on print, a booklet and a poster



A redesign of the logo and graphic identity for the City of Melbourne is one of the most recent released designs for a location, which has met a lot of appreciation within graphic designers' audiences. The logo itself and the way its identity functions is a quality demonstration of a contemporary tendency in graphic design, to design a dynamic, rather than static visualisations, where both the logo and accompanied graphic rules would constitute a system which would provide multiple versions of them. The identity's aspiration is to show the progressive-ness, transformation, diversity and vitality (City of Melbourne 2009 [online]). However, a logo may seem overly modernistic and is on a close border to being overly trendy and lacking essence.

On the other hand, it is important to note, that Melbourne's history counts less than 200 years, and controversially innovation and progressiveness may constitute the essence of this particular city and what makes its community proud of it. One must understand, that the specifications of each city might allow one aspect be central for an identity in fact, without being incommunicative.

As for the trend for modern open and flexible identities, which can also be seen in an example of a recent Copenhagen logo, there are strong advantages as well, as well as reasonable disadvantages, where the main is a high risk of obtaining another commonly oriented image unspecific of a location..



Fig. 13 The main logo of Copenhagen and its variations

OLD TO NEW

Another existing trend executed in a number of solutions is keeping a historical symbol adjusting it to modern reality of the city with contemporary design. The cities, such as Lyon, France and Tramelan, Switzerland have used the traditional symbols historically associated with the cities and depicted on their civic heraldry.

Serving to identify cities for centuries past, coats of arms may be viewed as symbol, which a logo is destined to compete with and eventually drive out. On the other hand, the rules of heraldry as well as usual depictions on it communicated about the particular cities' activities focus or power dominance in centuries past and generally on historical urban communities' arrangements. Opposite to modern logos, their ambition was mainly to inform rather than evoke a particular emotional reaction, especially as the cities were not as complex as they are now, and their urban focus and narratives could be easily depicted through a system of rules to construct a relatively simple graphic unity.

Lyon

The sufficiency of using historic symbols for cities' nowadays varies with specific examples. They certainly are mainly usable for historic cities or small cities with strong traditional community. For Lyon using the lion may be explained by emphasis and appreciation of the nation's historical power and significance common for France. The county's rich history is a strong part of national pride and introducing the traditional symbol of lion is the best way to re-identify the city for its community. What feels missing is a suffi-



Fig. 14 The modern Only Lyon logo features a lion, which has been a part of its civic heraldry since 1320.



Fig. 15 Royal coat of arms of Lyon

cient modernity to show the city's current direction. It is attempted, perhaps, in depicting a walking lion; however the overall impression does not provide information of the city's current dynamics..

Tramelan

In Tramelan, which is significantly smaller than Lyon, use of a traditional symbol is taken much further than in Lyon. The way a symbol is abstracted and used as a basis to a contemporary and inviting identity. A very clever design feels as face to a skilful identification of the development of a local community over the city's history counting back to 1441.



Fig. 16 The municipal coat of arms of Tramelan and it's development into a modern logo



Fig. 17 Application of the modern Tramelan identity on a series of materials

Conclusion

The aspiration of the above paper was to argue whether designs for city brands are able to represent respectful cities' thoroughly, preliminary presenting theoretical introduction and specific example reviews. After the conclusions were outlined from the case study, the analysis took a more specific focus in the following chapter to review those with a wider perspective. It has been derived, that the main difficulties in designing a representative identity include the complexity of contemporary urban territories and societies; a problem of a skilful incorporation of a city's historical background and modern ambition; and a mission of reaching different focus audiences, which are local community, visitors, job seekers, foreign investors and local stakeholders. The examples from

New York City demonstrated how a success of a city identity can be achieved: through either simple and bold statement addressing city users or a flexible modern identity. However, there are specific nuances to each city and identity, which help to fulfill the task; and merely choosing the main trend or direction, which proved to be successful, may not be characteristic enough for other specific cities. Thus, a flexible system of shapemasking worked much better for New York, then for Copenhagen.

Overall the conclusion is that although all aspects of the city's uniqueness are impossible to include in one symbol, a careful choice of focus or skilful combination of elements might work to create a durable and representative identity.

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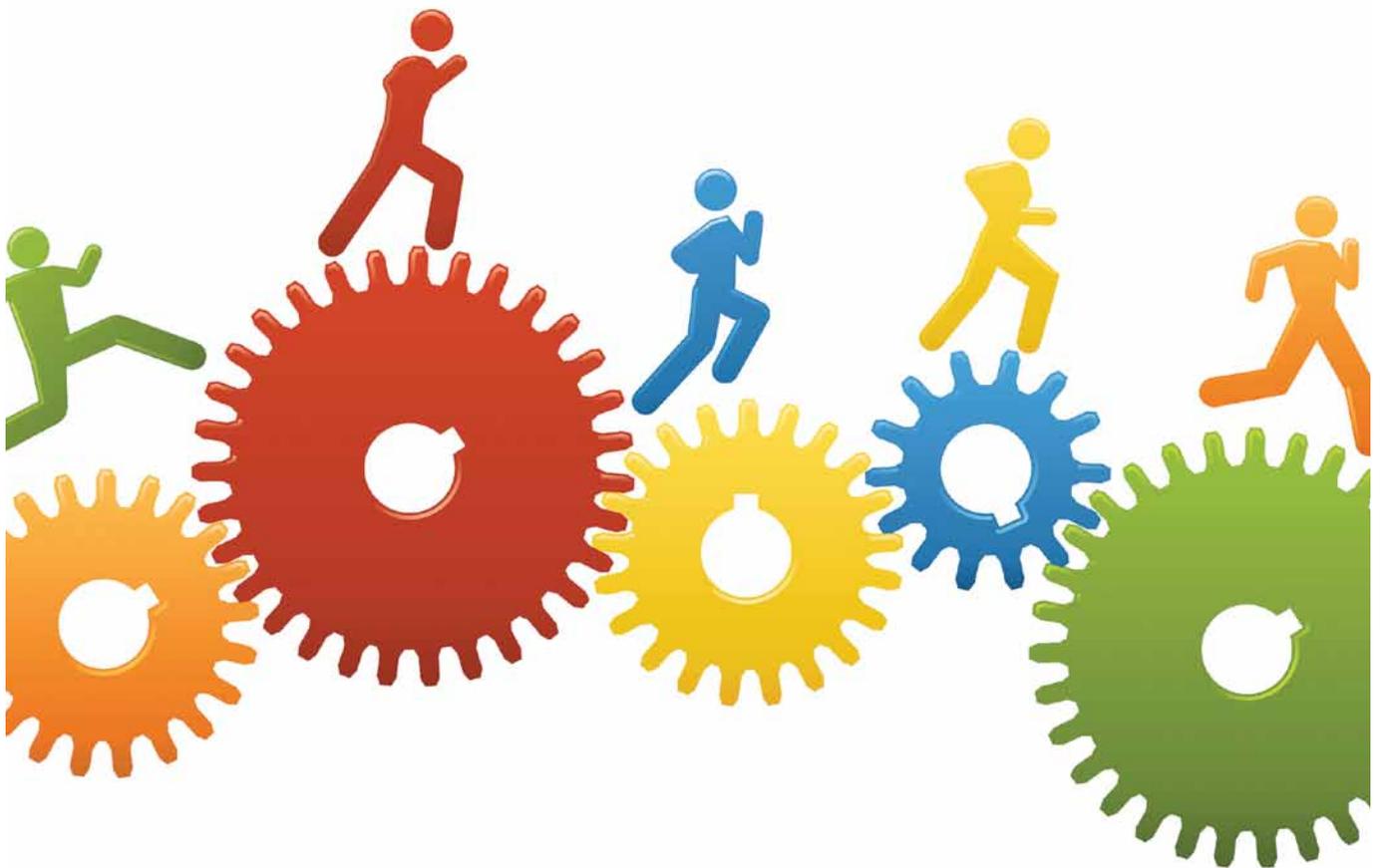
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Oksana Shmygol (BA Graphic Design)

Part IV:

School of Business



School of Business adopts the physical/ownership approach to learning. This is the concept of practical application of theoretical knowledge by using kinesthetic learning and embedded research. Within the classroom the School of Business empowers the student to become part of the learning process.

The Nature of Corporate Social Responsibility Examined from a Practical Perspective

Introduction

Corporations exist to provide products and services that produce profits for their shareholders. It has been argued that a corporation's purpose is to maximize returns to its shareholders, and that since only people can have social responsibilities,¹ corporations are only responsible to their shareholders and not to society as a whole. Although it is generally accepted that corporations should obey the laws of the countries within which they work, some groups assert that corporations have no other obligation to society. Some people perceive Corporate Social Responsibility (CSR) as incongruent with the very nature and purpose of business. Those who assert that CSR is incongruent with capitalism and are in favor of neoliberalism argue that improvements in health, longevity and/or infant mortality have been created by economic growth attributed to free enterprise.²

Our claim is that a corporate organisation exists only if there exist certain human individuals who are in certain circumstances and relationships, and our linguistic and social conventions establish that when those kinds of individuals exist in those of kinds of circumstances and relationships, they shall count as a corporate organisation. In addition we claim that a corporate organisation acts only if certain human individuals in the organisation performed certain actions in certain circumstances and our linguistic and social conventions establish that when those kinds of individuals perform those kinds of actions in those kind of circumstances, this shall count as an act of their corporate organisation.

At one extreme is the view that corporations act as individuals and have an intended objective for what they do if there are the rules that tie organisations together. They are morally responsible

for their actions and their actions are moral or immoral in exactly the same sense that a human beings are. The major problem with this view is that organisations do not seem to act or intend in the same sense that individual humans do.

At the other extreme is the view of philosophers who hold that it makes no sense to hold business organizations "morally responsible" or to say that they have "moral duties". Human individuals are responsible for what the corporation does because corporate actions flow wholly out of their choices and behaviors. If a corporation acts wrongly, it is because of what some individual or individuals in that corporation chose to do; if a corporation acts morally, it is because some individual or individuals in that corporation chose to have the corporation act morally.

Additionally as business is becoming increasingly global, corporations operate in many different countries. As a result multinationals are faced with a number of unique ethical dilemmas. Their presence in different countries and their activities will be controlled by the local government institutions, and this will therefore influence their moral behavior. Because they operate in countries at different levels of development and with different standards and norms, they must determine which risks and standards are ethically appropriate for a given country. Because their foreign operations become hostage to the governments of their host countries, they must therefore choose whether to go along with the many conflicting and sometimes morally questionable demands of these governments or risk losing some or all of their foreign investment.

Our intention is to examine the above controversial items from the point of view of one organization and examine the activities carried out in its CSR report. The company that will form part of this study is IKEA.³

¹ Carson, T., Friedman's Theory of Corporate Social Responsibility, *Business and professional Ethics Journal*, 12, Spring 1993, 3-32.

² Donaldson, T., and Preston, L.E., *The Stakeholder theory of the Corporation: Concepts, Evidence and Implications*, *Academy of Management Review*, 20, January 1995, 92-117.

³ The social responsibility initiative of IKEA can be found at <http://www.ic-mrindia.org/casestudies/catalogue/Business%20Ethics/BECG058.htm>

The Concept of Corporate Social Responsibility (CSR)

One view of Corporate Social Responsibility is concerned with a company knowing, managing and improving its impact on the economy, the environment and society. Increasingly, people with

a stake in that company (e.g. clients, suppliers, employees, funding organisations, advocacy groups and community groups) expect a company to be doing this. CSR is the continued commitment

by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their family and bringing a lot of benefits for the local community. The main components that make up a corporation's social responsibility are its economic responsibility to bring in revenue, make a profit and enhance brand image and reputation, ability to attract and retain employees and so on. They also have a legal responsibility to obey the law, an ethical responsibility to make sound business decisions that do not violate their code of conduct, and a moral responsibility to take into consideration, and contribute to the community. Corporations may also have a responsibility to their employees, investors, customers, and the general public to provide fair working conditions, not to discriminate, to provide economic security, and to act in a fair and honest way.

Some of the main elements of CSR from the point of view of stakeholder's demand may be summarised as follows:

- › Accountability
- › Transparency
- › Intergrated decision making
- › Sustainability
- › Ethical principles
- › Stakeholder engagement
- › Cautionary principle

In order to dig deeper into the functional role of the above elements and their effects on an organization we will examine the CSR report of IKEA. Firstly, we will briefly examine IKEA's corporate background. IKEA is one of the fastest growing furniture manufacturing companies in the world, it is a Swedish home furnishings retailer and has 231 stores in 36 countries, most of which are in Europe, with the rest in the United States, Canada, Asia and Australia. IKEA is one of the few store chains to have locations both in Israel and in other Middle Eastern nations, and it aims to be a responsible organization. It sells low-price home furnishing products around the world, these include furniture and accessories for kitchens, bedrooms, living rooms, bathrooms and children's rooms. IKEA is famous for its affordable furniture which consumers are required to assemble for themselves. Its catalogue, containing about 12,000 products, is printed in 160 million copies (2006) worldwide, and distributed free of charge.

IKEA's mission statement reads, "The IKEA vision is to create a better everyday life for people. This includes a lot more than just providing a great home furnishing offer. It is also about taking social and environmental responsibility towards IKEA customers, co-workers and the people who produce our products. The decision to integrate sustainability in all IKEA business strategies is a milestone for our continued work towards becoming a sustainable company".

IKEA's objectives can be detailed as follows:

- › Offer solutions and know-how that help customers live a more sustainable life at home.

- › Use natural resources in a sustainable manner within the entire value chain.
- › Minimise the carbon footprint from all IKEA related operations.
- › Take social responsibility, and act as a good global and local citizen.
- › Be transparent to all stakeholders, and communicate more to customers and co-workers.

Leadership is the key factor that establishes whether a company is long-sighted and able to integrate ethics successfully into strategy – the tone comes from the top. Only effective and dynamic leadership can set a corporate culture to prevent the reputational damage risked by unethical behavior. It can also transform the dangers posed by ethical challenges into commercial opportunities, thereby ensuring that the organization is fit for the future.

IKEA's corporate slogan—"Low price with meaning" is retained in IKEA's pragmatic, cost cutting sensibility. Waste is considered as a sin at IKEA; for example, employees are constantly reminded to save electricity by turning off lights and computers that are not in use. In IKEA, ethics is always a core part of company strategy. The link between ethics and business success has become far clearer in recent years, as companies realise that corporate interests must be aligned with the broader concerns of society if they are to survive. In a successful company, ethics is embedded in decision making and long-term strategy. "Doing the right thing" is not an afterthought that's bolted on to the mainstream activities of a company whose main aim is to generate profits. Successful, sustainable firms aspire to integrate ethics into all aspects of their corporate strategy.

IKEA labels the integration of ethical standards into its strategy as IWAY. IWAY specifies the requirements that IKEA places on suppliers of products and services. Suppliers are responsible for communicating the content of the IKEA code of conduct to their employees and sub-suppliers, below is a summary of some of the key points of IWAY¹.

1. Legal compliance

An IKEA supplier shall always comply with the most demanding requirements whether they are relevant applicable laws or IKEA IWAY specific requirements.

2. Start-up requirements

The following criteria need to be fulfilled before starting up a business relationship with IKEA:

- › No child labour.
- › No forced or bonded labour.
- › No severe environmental pollution.
- › No severe safety hazards.
- › A transparent and reliable system for records of working hours and wages.

1 Baert, I., The Corporate Social Responsibility of IKEA, Lund University Masters Program Thesis abstract can be found at http://www.lumes.lu.se/html/batch_6_2002-03.aspx

- › Insurance covering medical treatment for work related accidents to all workers.

3. Environmental standards

Suppliers shall have plans in place to reduce the environmental impacts from their production and operations.

Suppliers must:

- › Work to reduce energy consumption.
- › Prevent pollution to air, ground and water.
- › Handle, store and dispose of chemicals and hazardous waste in an environmentally safe manner.
- › Ensure that workers handling chemicals and hazardous waste have the right competence and are adequately trained.

4. Social and working conditions

IKEA expects its suppliers to respect fundamental human rights, and to treat their workers fairly and with respect.

Suppliers must:

- › Provide a healthy and safe working environment.
- › Provide health and safety training for workers.
- › Ensure their buildings are safe, have reasonable privacy, are quiet and have facilities for personal hygiene, in those instances where housing facilities are provided.
- › Pay at least the minimum legal wage and compensate for overtime.
- › Base overtime on voluntary agreements, not exceeding legal limits.
- › Allow time off and regular breaks.
- › Not discriminate on any basis.
- › Not prevent workers from exercising collective bargaining activities.
- › Not accept corporal punishment, threats of violence or other forms of mental or physical coercion.

Examining IKEA's objectives and the integration of the above code of conduct into its strategies, we realize that IKEA considers business ethics as a necessary matter for their development and it should be incorporated in their strategies and decisions for the success of their company's objectives. However we need to examine further what actions IKEA carries out in order to ensure that such ethical principles are embedded in the daily dealings of the company affairs. In order to do this we shall examine each area of stakeholders presented below.

Customers

First of all, we start with the customers who are an important key stakeholder in any business. Whether or not a business can survive depends on the value which customers receive from its products and services. IKEA is continually striving for ways to create added value for its customers.

As a result, IKEA has increased product testing to ensure quality and customer safety. Customers should always feel confident that products bought at IKEA are of good quality and safe and healthy to use. IKEA has increased the number of controls of manufactured products to ensure that they maintain the same strict safety standards they showed in laboratory testing before being included in the range for selling to customers.

Additionally, chemical management of IKEA in textile production was increased and formaldehyde emissions was reduced. IKEA helps selected IKEA textile suppliers to connect with chemical suppliers in a service based model referred to as "chemical leasing" in order to reduce the use of chemicals in manufacturing. This method is adapted from the car industry, and involves a technical specialist from the chemical supplier being placed at the textile supplier. IKEA has a vision that formaldehyde emission levels in wood based products shall be on the same levels as in natural wood. Already, a new standard for wood based board means that IKEA accepted formaldehyde levels will be half of the permitted EU level.

IKEA pays particular attention to children's products, which must meet especially high quality and safety requirements. IKEA tests children's products to strict national and international safety standards and legislation at independent, third-party test laboratories and institutes around the world. Tests are made before they start production and thereafter on a regular basis. Special risk assessment based on children's needs is a corner stone of IKEA's quality work during product development and in the production stage. The purpose is to detect and eliminate potential hazards and to ensure that the product is safe to use also in ways an adult may not normally anticipate. Co-workers across IKEA who work with the children's IKEA range in one way or the other go through regular training in the IKEA Children's School. IKEA's teachers both internal and external, are experts in their field and teach them about children's development and needs with focus on quality, safety and health.

From the Utilitarian² point of view we could interpret IKEA's actions as maximizing good and minimizing harm for those who are affected by their products. If IKEA does not concentrate its efforts to ensure the quality of their products but only focuses on profit margins then their products will become less competitive and their market share may be reduced due to customer demand for higher expectations. From one viewpoint, reduction in quality may reduce investment costs in technology in the short-run however the loss of market share in the long-run may be more detrimental. In a competitive market there are a lot of choices for the customer, so in the long run customers may realize that harmful products may have a bad influence on their health, customers may therefore shift their choices to other better products on the market, a kind of

2 A detailed theory of Utilitarianism can be found at <http://www.utilitarianism.com/mill2.htm>.

substitution effect may therefore result and the company's market share may be reduced due to their ethical reputation being damaged. Therefore, IKEA always focus on research and development of existing and new products to make sure that their products meet customer expectations.

Simultaneously, customers have the rights to the best quality of products/services and IKEA therefore has a responsibility to ensure that these rights are respected. If customers consume unsafe and unhealthy products, in the long-term they will realize that those products are bad for them. Moreover, when these products affect their health this can lead to increased social and medical costs and the burden of responsibility is therefore passed to the state. The government or press may intervene to investigate such incidents and as a result the company may be held morally responsible for the harm caused to its customers who may be affected by harmful products because they violated consumer rights. The company can incur higher costs in the long-run due to lawsuits or for illegal activities.

From a Kantian point of view³ we may argue that to act in a morally right way, people must act from duty. Secondly, Kant argues that it is not the consequences of actions that make them right or wrong but the motives of the person who carries out the action. Kant, for example, argues that the only absolutely good thing is good will, and so the single determining factor of whether an action is morally right is the will, or motive of the person involved in the action. If they are acting on a bad maxim, e.g. "I will lie", then their action is wrong, even if some good consequences come of it. IKEA may therefore be considered to have a "moral maxim" a kind of moral duty to their customers because they consider dishonesty to their customers as being morally wrong.

According to the view of justice, we can consider whether there is a fair distribution of benefits and burdens between the customers and the services provided by IKEA. If IKEA provides harmful products to the customers and customers purchase these products we could consider this as an unfair distribution of responsibilities as the customers are paying for unhealthy and inferior products, furthermore, the consequence of such harmful products also causes increasing burdens for the government and society in the form of increased healthcare.

IKEA strives to provide and serve their customers with high standards of products and services because the customer is the centre of the company and the company depends on trusting relations developed between customers over time, such trusting relations exchange value with the company and keeps its business running successfully. We can therefore see that "Trust" can develop due to the incorporation of responsibility and attending to a shared burden of duties, such moral characteristics being practically valued at the highest level of the psychology not only by the customer but

also by the corporation and therefore mobilizing the customer's loyalty with regard to the company.

Co - workers

If the customer is regarded as the heart of any business then co-workers (employees) can be considered as resources rather than business expenses. On the other hand, co-workers are a key stakeholder group. This is because co-workers have direct influence in the development of business organizations, in most cases, and act as channels of communication to the external environment and other stakeholder groups. Co-workers expect the firm to implement their commitment of the employment contract with fundamental clauses such as salary, working hours, insurance, working conditions etc.

IKEA strives to offer a safe and healthy work environment for all their co-workers. The safety of co-workers and customers is a top priority at IKEA, and much emphasis is placed on making sure co-workers get appropriate training and have access to the right tools and safety-gear. All co-workers within retail and distribution undergo safety-training before starting to work at IKEA. This includes training on how to use equipment and machinery, evacuation training, routines to prevent and handle workplace accidents, ergonomics etc. If appropriate, co-workers are also trained in how to handle threats – such as bomb threats –and robbery situations. Each country has its own safety committee with co-worker representatives, working actively to secure a safe working environment. Each IKEA unit also has a risk manager, responsible for local safety routines and drills based on the IKEA Group Risk manual and safety work.

IKEA respects the rights of people to work in safe and healthy working conditions beyond the interest of salaries, for example, one important thing is the level of care IKEA incorporates into its employee care policies and their working conditions. According to the Kantian perspective of reciprocity we should recognize it in ourselves, and recognize that others are equal to us. If I recognize that I have rights, others must also have rights and my actions towards them should therefore incorporate such a guiding ethical principle.

If IKEA has bad working conditions then their co-workers may be injured at the workplace due to lack of work place safety. Some of the consequences of such an event maybe the high cost of insurance, penalty, lawsuits and so on. In the long-term, this may also cause an increase of labor turnover and may damage IKEA's image. This affair will be seen by the general public and will not be good for IKEA as opinions may be formed of the maltreatment of employees. It is therefore important for IKEA to treat its co-workers fairly, in such situations we can see that there is a fair distribution of benefits and burdens. They treat their co-workers equally and the co-workers have opportunities to work in a safe and healthy working environment. The co-workers feel secure and ensure the benefits for their life, interests, family and so on. Moreover, IKEA sets the conditions for their co-workers by learning from experience. These are motivation factors to help IKEA get the most benefit from their

³ Details of Kant's moral philosophy can be found at <http://plato.stanford.edu/entries/kant-moral/>

co-workers as improving relationships with the company will have several long term benefits.

IKEA is also striving for diversity and equal opportunities and has become more creative and dynamic with a diverse work force, it strives to recruit co-workers of different backgrounds and experiences. IKEA managers around the world represent 50 different nationalities, and their overall ambition is to have a workforce that mirrors the diverse IKEA customer base. For instance, the IKEA store in Brent Park, UK, has co-workers of 20 different nationalities. The co-worker mix varies not only from state to state but from store to store, the East Palo Alto store in San Francisco has 23 percent co-workers with Asian origins and 34 percent with hispanic or Latino origins, while the Carson store in Los Angeles has 51 percent Hispanic/Latino co-workers and 10 percent Asian co-workers. IKEA strives for gender balance at all levels in the company. Today, there are more women than men working on the IKEA sales floors, but the share of female managers does not reflect that. The goal is to reach a 50–50 ratio.

We observe that there is equality of race in IKEA's working environment at several levels. As we see, they strive to provide equal opportunities for everyone who comes from different cultural backgrounds. Sexual and racial discrimination policies incorporate strong ethical elements that strive to prevent discrimination at IKEA, the needs of people from diverse backgrounds is respected and this helps the company and brings them good reputation and benefits from employee engagement and commitment.

Suppliers

Suppliers are a stakeholder whose concern is close to IKEA's operations. IKEA has a long-term trusting relationship with many suppliers. They want to work with suppliers who take responsibility for people and the environment, and who want to grow and develop with IKEA. As part of their continuous work to improve conditions in the supply chain, they have implemented a revised code of conduct, IWAY, and joined an industry collaboration program exploring the possibility of developing global supply chain standards. An IKEA supplier shall always comply with the most demanding requirements whether they are relevant applicable laws or IKEA IWAY specific requirements. Suppliers are responsible for communicating the content of the IKEA code of conduct to their employees and sub-suppliers.

IKEA uses IWAY⁴ (IKEA Way) to prevent child labor, it supports the United Nations (UN) Convention on the Rights of the Child (1989). IKEA requires that all suppliers shall recognise the UN Convention on the Rights of the Child, and take actions to prevent child labour. Suppliers must comply with all relevant national and international laws, regulations and provisions applicable in the

country of production. If child labour is found in any place of production, IKEA requires the supplier to implement a corrective action plan. The corrective action plan shall take the child's best interests into consideration and enable more viable and sustainable alternatives for the child's development. IKEA supports the legal employment of young workers. Young workers of legal working age have, until the age of 18, the right to be protected. IKEA requires all its suppliers to ensure that young workers are treated according to the law, including measures to avoid hazardous jobs, night shifts and ensure minimum wages. Limits for working hours and overtime should be set with special consideration to the worker's young age. Suppliers shall maintain documentation for every worker verifying the worker's date of birth.

According to the Kantian viewpoint we have moral duties to ourselves and others, such as developing our talents, and keeping our promises to others. The Kantian maxim⁵ "treat people as an end, and never as a means to an end" is the fundamental principle of guiding action that can be seen prevalent in IKEA's actions. That is, we should always treat people with dignity, and never use them as mere instruments. For Kant, we treat people as an end whenever our actions toward someone reflects the inherent value of that person.

IKEA also states that it does not accept corruption in any form, whether direct or indirect, and works proactively to prevent it. They clarify their position to suppliers through a vendor letter, signed by the supplier and an IKEA representative. The corruption policy details rules of Prevention of Corruption, and in addition an investigation policy which describes how co-workers should proceed if they suspect fraud, corruption, theft and other illegal behaviour are used as guiding principles. Firm policies and continuous training together with a strong corporate culture, helps to minimise the risk of illegal behaviour in the IKEA organisation.

From a moral point of view, corruption can be considered as an unjust action although the consequences may be beneficial and bring the company or the individual monetary benefits in the short-run. However, from one point of view, this may be considered as a matter of character however from a more practical point of view such actions tend towards an unfair distribution of wealth in a country and therefore contribute towards social and political unrest. Simultaneously, weighing costs and benefits, if one accepts corruption, then this could increase risk for the company from the legal point of view. Moreover, IKEA is a multinational company, so compliance with the law of each country is necessary, even if IKEA is regarded as a guest in that countries. If IKEA does not bring any benefits to the host countries then such host countries will have a unfair outlook to the future of IKEA and maybe prevent their operations.

⁴ The IKEA Code of Conduct, IWAY can be found at http://www.ikea.com/ms/en_GB/about_ikea/our_responsibility/iway/index.html.

⁵ The Kantian perspective on "Goodwill, moral worth and duty" can be found at <http://plato.stanford.edu/entries/kant-moral/#GooWilMorWorDut>

Communities

IKEA's Social Initiative supports programmes with the potential to yield big results from many small steps, fighting for children's rights for a healthy and secure childhood with access to quality education. Including this year's new long-term commitments and projects supported by proceeds from the annual campaign "One euro is a fortune", IKEA's Social Initiative projects are expected to benefit more than 100 million children.

IKEA wants to be a good neighbour in the local community. Below, are a few examples of national and local initiatives being undertaken to support the homeless. IKEA, France has a partnership with Fondation Abbé Pierre which provides housing and meeting places for the homeless. IKEA supports this organisation by furnishing and decorating day-time activity centres and housing facilities with individual apartments and communal areas. Since the start in 2005, IKEA has donated products and home furnishing advice to 25 Fondation Abbé Pierre projects. Co-workers volunteer their time, and IKEA customers contribute through an annual in-store campaign. The IKEA store in South Philadelphia, USA, cooperates with Safe home Philadelphia to help children of homeless families have a better everyday life and a warm, safe and comfortable place to sleep. IKEA donates beds and accessories to children of families who have been provided permanent housing by Safe home Philadelphia, but who by the time they get into their house have little or no personal belongings.

IKEA also supports "Sow a Seed"⁶, a project aiming to re-forest and maintain 18,500 hectares of lowland forest in Sabah in Malaysian Borneo, and to protect the area from logging for a period of 50 years. Since the start in 1998, around 8,800 hectares of forest have been re-planted with native tree species. The project has also contributed to the building of homes and the creation of meeting places for social events, and field accommodations for more than 150 local workers and their families. "Sow a Seed" is a partnership between IKEA, the Swedish University of Agricultural Sciences, the Yayasan Sabah Group and the Malaysian forestry company RBJ.

In addition, IKEA works with World Resources Institute and Global Forest Watch⁷ to raise awareness and knowledge of sustainable forest management. This project, which also partners with Greenpeace Russia and Siberian Environmental Centre, has now involved over 5,000 students in 250 schools across Russia, and has been extended to 30 schools in Belarus. In addition, the project included a Summer Forestry School in 2009 for 140 school children in cooperation with local environmental organisations in the Republic of Altai.

One part of the project is creating a new database for forest monitoring, Ecomonitor. The long-term ambition is to set up an interactive website for public monitoring of valuable forests and other natural areas, an important step in promoting modern information technologies for use in education and research. The degree to which ethical community investment is embedded in IKEA's strategic planning and operations is important for a number of reasons. Ethical community investment is likely to affect more potential beneficiaries, and be more consistent with other aspects of management and CSR. Most importantly, it is more sustainable than a peripheral or bolt-on approach during times when profits are under pressure.

Community involvement will be seen as a responsible step by the local community and this can contribute to improve the image of the company. Activities such as involvement with the local community are ideal opportunities to generate positive press coverage. Good relationships with the local community will improve employee engagement, customer loyalty and the company's reputation. A number of community investment programs provide opportunities for hosting important stakeholders. When hosting customers or suppliers this can be seen as a commercial investment and when it provides access to socio-political or interest groups, it can be seen as an opportunity relating to a license to operate. Good relationships with local authorities make doing business easier. It's not only good for the overall community, it enhances community trust and this is good for business. Our belief is that profits and social responsibilities need not be in conflict. In fact there is no denying that companies with strong positive ethical reputations are typically financially successful ones. Society and the bottom line are the two issues that will put pressure on companies to be ethical.

The interests of long-term shareholders are a sustainable high performance indicator over time and a focus on short-term performance can damage that. Building superior long-term value requires advancing the interests of all stakeholders including the community. Building trust is necessary for the successful longevity of any business enterprise. Winning companies focus not only on what they can gain from success, but on how they can contribute back to the community.

Environment

IKEA works actively to minimise the environmental impact from all their operations. They have a holistic perspective on the entire value chain – from the initial design stage to the end of a product's life-cycle. They focus on four areas of particular importance, where they are also beginning to see positive results. IKEA always strives to design and develop products that require the least possible amount of resources, and that integrate solutions for minimising a product's environmental impact throughout its life-cycle. They hate waste in every form, and try to make good use of spill material from manufacturing for new products whenever possible. They have

⁶ Details of this project can be found at http://www.ikea.com/ms/en_GB/about_ikea/our_responsibility/ikea_forest_projects/sow_a_seed.html

⁷ Details of IKEA "Forest Projects" can be found at http://www.ikea.com/ms/en_GB/about_ikea/our_responsibility/ikea_forest_projects/index.html

decided to develop affordable products that contribute to a more sustainable life at home for their customers and can help them save energy and water and to minimise household waste – simple measures that contribute to a better world and save on household expenses. IKEA wants to offer solutions and know-how that enable their customers to live a more sustainable life at home by saving energy and water and minimising household waste. At the same time, they are adopting a more systematic approach to developing resource-efficient products with a minimal environmental impact throughout the product's life-cycle.

Forestry and wood

Wood is an excellent material from a quality and environmental perspective, as long as it is legally produced and comes from responsibly managed forests. IKEA does not accept wood that is illegally logged or that comes from intact natural forests. Their long-term goal is to source all wood for IKEA products from forests certified as responsibly managed. IKEA works with a step-by-step staircase model to place increasingly higher demands on suppliers of wood for IKEA products. The staircase model is applicable to all suppliers of IKEA articles that contain solid wood, veneer, plywood or layer glued wood.

IKEA Group's forestry specialists are working in the field in their key wood-sourcing regions. These forestry specialists support business development towards the long-term goal of sourcing all wood used in the IKEA range from forests certified as responsibly managed, and they help the IKEA trading service offices to trace the wood back to its origins. Cotton is one of their most important raw materials, and they want the cotton used in their products to be produced in a sustainable manner. They have increased their engagement in a number of activities deep into a long and complex supply chain in order to speed up results and move closer to sustainable cotton cultivation and processing.

From a Kantian perspective, an action is morally right in a certain situation if, and only if, the person's reason for carrying out the action is a reason that he or she would be willing to have every person act on in any similar situation. If we do not protect the environment then our wrong actions lead to an environmental crisis. As we know, the problem we are facing is depicted by the facts about global warming, rising sea levels and extinction of polar animals, the effects of acid rain, the pollution of air, soil and water, and the depletion of the ozone layer. Many deep ecologists concentrate their ethical codes and philosophies on how we treat other human being and also with how we treat non-human beings, including animals, plants, and nature generally. To value other species ethically, we need to have a revolution in human attitudes and we should treat them as ends in themselves, rather than merely as means to human ends. Non-human species should be regarded as having a right to exist, a right not to be polluted or damaged or destroyed. According to Paul Taylor, an attitude of respect for

nature commits us to perceiving wild animals and plants as having a good of their own which human beings have a duty to respect.

William T. Blackstone⁸ has argued that the possession of a livable environment is something to which every human being has a right. To some extent, U.S. federal law recognises this concept. The main difficulty with Blackstone's view, however, is that it fails to provide any guidance on several pressing environmental choices. This lack of nuance in the absolute rights approach is especially problematic when costs are high in comparison to the benefits that will be attained. However, with regard to Utilitarians, they see environmental problems as market defects, arguing that pollution should be avoided because it harms society's welfare.

In addition, the price will be not accurately reflect all of the costs of a commodity because the divergence of private and social costs is problematic. As IKEA wants to make it easier for their customers to use public transportation to travel to and from the store. Wherever possible, they are working to secure good connections between IKEA and public transport systems. In some countries there are free shuttle buses for customers to travel to IKEA from surrounding urban areas. IKEA in some countries offers a reduced price for a home delivery service for customers considering using public transport so that they can take their purchases home and in addition all IKEA Group company cars will be "green" by 2010. With this way of product transportation, IKEA focuses to reduce pollution.

This way of dealing with pollution is consistent with the requirements of distributive justice. Since pollution's external costs are largely borne by the poor, pollution produces a net flow of benefits away from the poor and towards the rich. Internalizing these costs can reverse this flow. Internalizing external costs are also consistent with retributive and compensatory justice, because those who are responsible for pollution bear the burden of rectifying it and compensating those who have been harmed. Taken together, the requirements imply that:

- a. The costs of pollution control should be borne by those who cause pollution and who have benefited from pollution activities as both stockholders and customers benefit from the polluting activities of firm.
- b. The benefits of pollution control should flow to those who have had to bear the external costs of pollution.

As we deplete the world's resources, there is unavoidably a smaller amount of resources left for future generations. If future generations have an equal right to the world's resources, then by depleting them we are stealing what is actually theirs. Do we not have a responsibility to our future generations? A number of writers have claimed that is a mistake to think that future generations have rights. First, future generations cannot intelligently be said to have rights because they do not now exist and may never exist. Additionally, if future generations did have rights, we might

8 Blackstone, W.T., *Ethics and Ecology*, Southern Journal of Philosophy, Vol 11, Issue 1-2, pages 55-71, Spring-Summer 1973.

be led to the absurd conclusion that we must sacrifice our entire civilization for their sake. Suppose that each of the infinite number of future generations had an equal right to the world's oil supply. Then we would have to divide the oil equally among them all, and our share would be a few quarts at the most. We can say that someone has a certain right only if we know that he or she has a certain interest that that right protects. The purpose of a right, after all, is to protect the interests of the right holder, but we are virtually ignorant of what interests future generation will have. What wants will they have?

On the other hand, John Rawls⁹ argues that though it is unjust to improve heavy burdens on present generations for the sake of the future, it is also unjust for present generation to leave nothing for

the future. We should ask ourselves what we can reasonably expect they might want and, putting ourselves in their place, leave what we would like them to have left for us. Justice, in short, requires that we hand over to our children a world in no worse condition than the one we received ourselves. With regard to us, the assumption of infinite number of future generation is also correct, we can see from present statistics that world population growth will increase and as a result so will the requirements of future generations therefore, we do in some ways have responsibilities for our future generations and these need to be defined. We can see that from IKEA's way of utilizing resources, we can not only maximise our benefits from using resource but also minimize the harm for future generations and ensure their rights.

⁹ Rawls, J., *The Theory of Justice as Fairness* can be found at <http://plato.stanford.edu/entries/rawls/>

Conclusion

According to Dr. Eugene Trinh (NASA Scientist and Astronaut) "...if you look at the Earth from Space you do not observe any countries, there are no boundaries on the Earth until you come closer to the country next to you..". The Earth can therefore be considered as a "common roof" for the whole of humanity. From this point of view, we can think that everyone is living under the same roof, so we need to have responsibilities and care for ourselves and other species under this "common roof" and protect this "roof". Otherwise, each one of us will need to change our attitudes with regard to the environment and the consequences of our actions. We have shown that if we consider IKEA as an "individual unit" amongst other "individual units" in a large business world then IKEA has similar responsibilities and ethical concerns as us all, these concerns can be reflected in the responsible ethical activities of IKEA detailed in their CSR report.

We have also attempted to show that such activities can be part of any CSR strategy that can be incorporated within the activities of organizations. Not only IKEA, but any business should be responsible for such key ethical outlooks for their future, as people want to buy from businesses they respect and trust. Publicity is also a key part of using CSR to win contracts and CSR can be particularly effective for targeting greater market share. At the same time, any company should view CSR as part of a continuing process of building a long-term successful organization. Even with dozens of competitors, a real commitment to CSR lets any company stand out. The company's commitment to CSR feeds through into customer service, sales and profits and as well as affecting the way the company behaves and also guiding its corporate strategy, CSR can lead to new products and services that reflect corporate values and those of

its stakeholders. Over time, it can all add up to a powerful brand and build customer loyalty in an increasingly interconnected competitive business world.

Dung Viet Phan (Student, School of Business) ,
Bruce Gahir (School of Business)

Adapting Porter's Value Chain Analysis

Value Chain Analysis - Developing the Generic Model

Abstract

The concept behind this paper is an examination of Michael Porter's Value Chain Analysis (VCA), which is an analytical tool designed to aid managers understand how their organisations can analyse sources of competitive advantage. The limitations of this tool are that it is designed for medium to large sized manufacturing organisations. It is not as adaptable to small businesses and also to services industry as a whole.

Porter's concept of Value in a highly competitive business environment rings even truer in the current turbulent times. Many businesses do not offer just products or services. The vast majority can be said to create customer offerings, i.e. a mix of product and service. In the United States 91% of small businesses can be categorised as such types. This model will therefore be applied to a services industry, for which VCA was not originally designed to understand

This paper takes Porter's VCA model for manufacturing a product and will apply it to alternate business types. It will examine the Value Chain for an organisation that provides some form of service to its customers. As a further adaptation of the model this paper will also look at how the VCA for services can be further developed to match the internal organisation of activities of a private university. Porter believed that an organisation was composed internally of a series of activities. Activities in this sense are the means by which a firm creates its products. Traditionally these activities have been organised into departments and divisions. This top down structure although effective for control, as organisations are becoming increasingly more sophisticated and thereby more complicated, becomes unwieldy and sluggish. Porter believes that competitive advantage arises out of the way a firm organizes and performs activities. He wrote that an organisation had to look at itself not from the functional perspective but from a strategic one.

Porter's Value Chain Analysis Model

The overall aim or purpose of an organisation can be described as one in which they compete to sell to customers something that the competition cannot match in the form of a product and/or service. This is described as having competitive advantage. Porter wrote and created the Value Chain Analysis model as an aid to co-ordinating firstly the use of resources and combining them with organisational competences. By analysing the use of resources and competences, both of which incur costs to the organisation,

Porter believed cost leadership or differentiation strategies could be developed by understanding the linkages between activities undertaken. In addition this Porter states that an organisation can only gain competitive advantage by analysing the relationship between activities. The relationships between what Porter describes as interdependent activities are called linkages. The quality or value of these links is the ability to understand and co-ordinate the separate activities towards some form of common goal, which Porter calls the Value Concept.

This valuable tool is the standard recommended aid for all managers and students since it was published in 1985. As a generic tool it helps an organisation understand the how the coordination of activities that can lead to competitive advantage.

External Business Environment

The external environment is a set of conditions that exist outside an organisation that affects its ability to compete effectively within a market or an industry. These factors or conditions can be split into the general environment and the competitive environment. Both environments contain environmental factors that have a complicated relationship between themselves and effect upon the individual organisation. The result of these effects and interdependent relationships are uncertain and complex and continually changing. These changes impact upon the individual organisation forcing it to react. This is due to the fact that they create either Opportunities or Threats for an organisation. Changes in the General environment normally effects the perceptions, expectations, need and wants of customers, this can be described as potential profit. Changes in the competitive environment affect the level of completion within an industry. By understanding both environments the decision makers in organisations can understand the profit potential of opportunities that exist. Although this may seem a simple prospect, the instability of the Business Environment means that managers must constantly monitor these changes in order to remain competitive.

Age of Turbulence

"In a constantly changing world the only constant is change"

This concept that the Strategic Business Environment is an uncertain, unstable and increasingly unpredictable one is also Philip Kotler's view of the external environment. In his book *Chaotics* he comments that Globalization and technology are the two main forces that helped to create a new level of interlocking fragility in the world economy. While global interdependence works in

everyone's favor in good times, it rapidly spreads much pain and damage in bad times. Turbulence, with its consequent chaos, risk, and uncertainty, is now the "new normality" for industries, markets, and companies as we enter into the Age of Turbulence (Chaotics).

This Turbulence affects managers when they make strategic decisions about how to react to an opportunity or threat. To further compound this they also operate within a set of conditions that are imperfect, as they do so with incomplete information and bounded rationality thereby increasing the risk factor of a wrong decision being made. Strategies are merely a set of decisions that take an organisation from one strategic position within the environment to a more favourable one. These decisions are formalised for communication purposes as a Plan. Planning is difficult and risky matter. If predictions are wrong and strategies fail organizations performance falls. There are though many benefits that planning can bring to an organisation. Planning is necessary to give organization a sense of direction and purpose. Planning is a useful way of getting managers to participate in decision making about appropriate goals and strategies for an organization. Planning co-ordinates managers of different functions and divisions of an organization towards a common goal or shared objective. A plan can also be used as a device for controlling managers within an organization as it assigns roles and responsibility.

The theoretical approach to business planning provides a process or a set of instructions on how to prepare and implement strategic change in a business plan. It also gives a series of analytical tools that allow a more effective collation and analysis of information in order to provide a set of informed decisions that will allow an organisation to overcome the inherent condition of limited information and bounded rationality.

Market Focus and the concept of value

Although the external business environment within which all organisations operate has always been a fast changing competitive environment, the rapid pace at which forces in the global environment are now changing is causing managers at all levels and at all types of companies to continually re-examine the way their product creates value for their customers and to find ways to increase that value. Globalisation and the exponential pace of technological advances are some of the main reasons why the external business environment is so unstable. As a reaction to this the concept of strategic management is the now concerned with the continuous monitoring of the business environment in order to identify changes in the needs, wants and expectations of their customer. It's only by understanding the customer and satisfying them can an organisation maintain its competitiveness. Nigel Piercy states that customer satisfaction has to be at the heart of every decision made within the organisation. If an organisation merely focuses on the product itself, it can be said to have a product focus. These organisations are traditionally slow to react to these changes and lose competitive advantage or the

ability gain it over competitors.

A market focus organisation always tries to understand the customer's concept of value. It then seeks to satisfy it by adjusting its offering to the customer. Customers purchase value, which they measure by comparing a firm's products and services with similar offerings by competitors. The business creates value by carrying out its activities either more efficiently than other businesses, or combines them in a way as to provide products and/or services that differentiates itself in the market or industry.

In this respect strategy is the only way a company defines its business and links together the only resources that really matter in today's market focussed economy: knowledge and relationships or an organisations competences and customers.

"In a fast changing competitive environment, the fundamental logic of value creation is also changing and in a way that makes clear strategic thinking more important and more difficult. Global competition, changing markets and new technologies are opening qualitatively new ways of creating value." (Value Chain to Value Constellation: Designing Interactive Strategy Normann and Ramirez)

In so a volatile a competitive environment, strategy is no longer a matter of positioning a fixed set of activities along a value chain. Their focus of strategic analysis is not the company or even the industry but the value creating system itself, within which different economic actors – suppliers, business partners, allies and customers - work together to create value. Their key strategic task is to understand configure new roles and relationships among this set in order to mobilise the creation of value. The underlying strategic aim is to create a continuous improving fit between competences and customers

Value Chain for Manufacturing

The value chain is a concept from business management that was first described by Michael Porter in, *Competitive Advantage: Creating and Sustaining Superior Performance*. Porter developed a value chain model of organisational activities. Porter believes that competitive advantage arises out of the way a firm organizes and performs activities. The organisation has to bring value to the customer by creating or modifying the existing product or service, and it can be achieved by understanding the value creating activities the organization undertakes when creating the products or service. This model is a generic tool, and is flexibly designed for managers and leaders of organisation to be able to adapt their unique internal environment into this generic conceptual model. A six-time winner of the McKinsey Award for the best Harvard Business Review article of the year, Professor Porter is the most cited author in business and economics.

Activities: the means by which a firm creates value in its products. Sometimes referred to as value activities

Porter groups the various activities of an organisation into a value chain. He groups the activities of an organisation into support and primary activities.

Porters Value Chain Analysis Model

Primary activities are considered to be inbound logistics, operations, outbound logistics, Marketing and Sales and after sales service.

Primary activities are directly related to production, sales, marketing, delivery and service

Support activities are Procurement, Technology development, Human Resource Management and Management planning.

Support activities provide purchased inputs, human resources, technology and infrastructural functions to support the primary activities.

In order to be able to adapt the Value Chain to the service industries we first need to have a clear understanding of the existing model for the manufacturing industry. The success of the company depends on how the organization as a whole performs, while the competitive advantage arises from the individual activities the firm performs. (Thompson, 2005) "Value Chain analysis is a systematic way of studying direct and support activities undertaken by a firm. From this analyses should arise greater awareness concerning costs and the potential for lower costs and for differentiation" (Thompson, 2005) Porter (1985) argues that competitive advantage is created when an organization performs the most crucial functions either more cheaply or better than the competitors.

The Value Chain is composed of activities undertaken by a firm in order to create value; those activities are divided into the Primary Activities and the Secondary/Support Activities. Primary activities represent activities of physically creating a product or service. These activities consist of five stages: inbound logistics, operations' stage, outbound logistics, marketing and sales and the after-sales service. Inbound logistics are the activities related to the receiving, storing and distributing internally the inputs to the products or services. Operations are the activities related to the transformation of the inputs into the finished products and services. Outbound logistics are the activities of distribution of finished goods to the customers. Marketing and Sales include advertising, promotion and actual sales. The last stage of After-Sales and Service include the communication with the customers after the actual sale is made, such is installation, repair, etc.

Additionally, the Secondary activities support the primary activities by supporting the effectiveness and efficiency of those stages. Secondary Activities are: HR, procurement, infrastructure and technology development. HR includes recruiting, training, motivating and developing the employees. Procurement refers to the purchasing the inputs used in the value chain. Infrastructure is the firm's organizational structure, planning, management designed to support the primary activities in the value chain. Use of technology can support one or more of the primary activities by using innovations to reduce costs, improve communication-anything that can add value to the final product. Every one of primary and support activities should add value to the product

or service. For a long time this model has been the standard, and according to Porter, using this Value Chain can offer an understanding of competitive advantage.

Adapting the Value Chain to a services industry

The limitation of this model for the service industry is due to firstly the descriptors that Porter uses to describe the primary and secondary activities. Secondly for manufacturing companies the model is useful as it is able to accurately reciprocate the input output flow of a product as it is being created. The activities that take place are in a logical sequential order. However in terms of a services industry the terms used in Porter's Value Chain Analysis e.g. the inbound and outbound logistics are not really present in the service industries. In manufacturing industry, operations can take place isolated from the customer, while in the service industries creation and actual usage of the service occur simultaneously. The infrastructure can also differ in the service industry, while some of the supporting activities would stay the same. When providing a service, an organisation is not concerned with an individual tangible product that can be manufactured, distributed and then marketed in retail outlets for customers to come and select. There is no product to take from the factory and then distribute. A service is an intangible concept. There is no sequential set of activities; indeed often all activities are taking place in a continual cyclical context. A customer may interact with the organisation many times if not continuously. The effectiveness of it is measured by the emotional response of the consumer. Has the customer been satisfied? Have the customer's needs and wants been met, or does the offering need to be adjusted to improve the levels of satisfaction.

Linkages in the Chain

In a services organisation the critical linkages between activities become more important. These links are simply the communication and the co-ordination decisions of the senior management. Communication is the sharing of information between two or more individuals or groups in order to reach a common understanding. First and foremost communication is a human endeavor and involves individuals and groups. For communication to take place there must be a common understanding. Organisations gain competitive advantage when managers strive to increase efficiency, quality, responsiveness and innovation. Good communication is essential for attaining each of these four goals and thus necessary for gaining competitive advantage.

Managers can increase efficiency by updating the production process to take advantage of new more efficient technologies and by training workers to operate new tech and expand skills – discuss how ineffective comm. can hinder this

Also improving quality hinges on effective communication. Managers need to communicate to members of an organization the meaning and importance of high quality and the routes to attaining it. Subordinates need to communicate quality problems and suggestions for increasing quality to their superiors and members of self managed teams need to share their ideas on improving quality with one another

Good Communications also can help increase responsiveness to customers. When the organisational members who are closest to customers i.e. dept. store salespeople and bank tellers are empowered to communicate customers needs and desires to managers, managers are then better able to respond to these needs. Managers in turn must communicate with other organisational members to determine how best to respond changing customers preferences – Multi distribution channels, conveying effectiveness of benefits to customers about new products.

Value Concept

In order to adapt the Value Chain Analysis for a services environment the first thing that needs to be done is to understand what is meant by this term. The service sector consists of the “soft” parts of the economy, i.e. activities where people offer their knowledge and time to improve productivity, performance, potential, and sustainability. The basic characteristic of this sector is the production of services instead of end products. Services (also known as “intangible goods”) include attention, advice, experience, and discussion. The descriptors for the Primary and Secondary activities need therefore to take into account these characteristics. Ultimately Customers purchase value, which they measure by comparing a firm’s products and services with similar offerings by competitors. The business creates value by carrying out its activities effectively and efficiently. Example of a restaurant – they merely buy food, cook it and serve it. All these things in theory can be done at home. The customer is prepared to pay for someone else to do all this and also pay more for the food than the actual cost of the resource. The restaurant can measure the value created by the amount customers are willing to pay for its product and service. A firm will be profitable if the realized value to customers exceeds the collective cost of performing these activities. The same could also be said of a university surviving in a highly competitive market, with a potential global market. In this situation the market potential can be said to be opportunistic. In reality though, private university education, for its relatively high purchase costs is simply an exchange of knowledge. In the previous example a potential customer has the option of either cooking himself a meal, or letting a far better qualified professional using the same ingredients do a better job at the process thereby providing a valuable service. For universities the service is taking information from a book and passing that information to the student. The student could also perform this

function simply by reading a book. The concept of value in this context is the level of quality in the service and the way it matches the needs and wants of the customers. The higher the concept of value your customer perceives in the product/service offering, the more they will be prepared to pay for the service.

Creating Value from the Chain

Co-ordination of Primary and Support activities are the only ways of creating value within an organisation. Strategy is not a matter of simply positioning a fixed set of activities as in the value chain. Successful companies do not just add value they create it. Key strategic task is to reconfigure roles/relationships. Mobilise the creation of value by new combinations of players. “New logic of value breaks down distinctions between products and services and combines them into activity based offerings from which customers can create value for themselves” (Ramirez). Company’s strategic task becomes the ongoing realignment and integration of its competencies and its customers. An organisation seeks to create value through its activities because this is the most effective way of optimising use of resources. An organisation could simply add value by spending money. That means though that those resources can no longer be used to improve the overall efficiency and effectiveness of the company which is the concept behind the market focus approach to strategic planning. This approach states that in order for a company to survive it must follow the dictates of the market. All organisations must follow the dictate of the market to survive. This means that organisational effectiveness can be pursued by being market led, focusing on the customer. Barriers to being market led come not from ignorance of customer characteristics, but from the way organisations are run, organised and co-ordinated. Becoming market-led often means upheaval and change for an organisation, and it must have a clear understanding that strategic change is not just about hiring a marketing executive.

Therefore internal programs and external actions are driven by strategies, and these are based on customers and markets. This means that for overall effectiveness cross functional teams must cross organisational boundaries. This increase in communication and understanding naturally leads to new relationships are created being focussed around once concept; the needs and wants of the customers.

In the current business market where high levels of competition, and the rapid pace at which forces in the global environment are changing all types of companies need to re-examine the way their product creates value for their customers and to find ways to increase that value.

The concept of the needs and wants of the customer are far more fluid. It is the needs and wants you are satisfying when presenting your offering. In both models support activities are considered overheads. In other words they represent voluntary purchase decisions. Support activities which are purchased (we

have a choice again about how to invest in these areas) must also be organised in a way that allows the Primary activities to fulfil their objectives. A secondary activity that does not in combination with a primary activity create value can be considered as an inefficient use of resources. Activities incur costs and in combination with other activities, provide a product or service which earns revenue.

New Descriptors for the VCA

The primary activities for the service industry would be:

- > Value Inputs (bringing in knowledge and experience, skilled, motivated people, talent)
- > Induction (creating offerings and selections)
- > Promotion (communication the benefits of the service)
- > Delivery (giving customers the level of service/offering they desire)
- > Intelligence and Research (feedback, customers' knowledge, after-sales communication with the customers)

Secondary activities for the service industry would be:

- > Organizational knowledge – intangible assets the organisation possess. Motivation, Talent, Experience and Knowledge. These resources must be organised into systems or they have no value
- > Value adding unit – These are the additional purchases/ investments an organisation makes. Scholarships, Internships, Sponsorship, Research Centers are examples of activities
- > Internal values – This is the culture, structure, management style, decision making.
- > Technology development – enabling the organisation to continually match and exceed increasingly higher customer expectations and also technological development

These new descriptors allow for a far more accurate description of the interrelated activities that occur in a services context. In order to give greater depth this new model will be used to analyse and understand the activities that take place within a Private University.

Value Inputs

Value inputs are the starting point for the Service related organisation. These inputs represent decisions on expenditure of financial resources to purchase additional external resources to bring into the organisation. Although there are still necessary physical inputs required, the main type of resources that concern a services company would be knowledge of the customer's needs and wants, relationships with the market and most importantly human resources. The greatest asset a services organisation has is its human resources. These inputs are far more intangible than the physical inputs found in the original VCA. For example private universities Value Inputs could be getting accreditation and license. The second step would be finding good, skilled, motivated, driven staff. Organizational knowledge: having experienced and skilled

teachers, as well as having diverse and multinational, driven and talented students, to create a multi-cultural, dynamic motivating environment where students and teachers are actively encouraged to share their experience and knowledge with each other. Organizational knowledge can support the first stage of Value inputs by training and retaining staff that bring value, reputation and prestige to the university. By co-ordinating external relationships with other institutions and universities, knowledge can bring into the institution as part of the Value Inputs. This activity typically could be supported by the Value Adding Unit in its function of guest speakers, exhibitions, etc. Another area is recruitment. New members of an organisation who are recruited must be selected to fit the needs of the organisation and believe in the learning styles of the organisation. This concept of Value being purchased, recruiting and retaining the best is however not a cheap option. If the cost is exceeded by the value the input brings, in other words it creates far more effective value at other primary stages then it is regarded as an effective use of resources. Here the support activities of Internal Values and Organisational Knowledge have a directing influence

Creation of Offerings

At this stage the organisation takes its resources that have come from outside of the organisation and combines with the support activities. It is at this stage that the courses and classes will be created and offered to students. The creation of class schedules and times that are designed with the needs and wants of the different customer segments, flexible learning platforms that satisfy the various lifestyles and commitments of individuals, diverse and practical subject offerings portfolio that matches the customers future development needs. For this to happen it is vital that the support activities interact closely with this stage. Decisions made in isolation will never be able to fully integrate the concept customer satisfaction and value.

Organizational Knowledge: experienced staff can identify the learning styles of the students, as well as his wishes about the future job and occupation and based on that; fit them in to the right subject areas, classes and teacher. In this type of learning environment the objective is create balanced groups of students who can learn from each other and the lecturer through shared experience.

Value adding unit: online and distance courses with the help of technology development support activity can be offered to attract more customers: students for Bachelors programmes, as well as for the Masters one. Corporate customers and students of the Masters programmes would value the online and distant programmes (due to the possible conflict of work and study in the usual programme), this way they can participate in the studying process when they have free time, and not having the courses conflicting with their current job.

Another value adding offering can be having Guest Speakers who would help students gain real-life practical knowledge

and understanding of the theory they learn in class, meet new interesting people, share experience, and listen to useful advices from talented and experiences guest speakers.

Internal values can bring value to the students in terms of creating for the customers learning environment and culture, in which the students as well as teachers will be willing and ready to learn new things from each other, share experience and possibly study in "cross-functional classes", where students from different majors can have the same classes, and therefore share different ideas on certain topics from the perspectives of their major.

Another value creating activity, as part of the Value Adding unit could be in the form of scholarships, so that the driven, talented and motivated students would get in, this will have a great effect knock on effect for both teachers and students as well, having the constant interaction, group projects and sharing the experience, talent and motivating each other.

Another Offering supported by Value Adding Unit could be to increase the value of the service provided by assisting students' need-ability to find a good job after the graduation. Since the whole reason for gaining an academic qualification is to be able to find a good job, University could help by offering internships for students during their last semester of studies. This would allow them an idea of what job they want to have and try different options, gain practical experience, and if the feeling of satisfaction from work will be mutual from the student's and the employer's side-then continue with the full time work after the graduation. This concept could be further developed by having partnerships with suppliers of graduate's i.e. recruitment agencies who could facilitate the process further by using their contacts within the industry.

Promotion

In the traditional VCA model, you produce the product and distribute it either directly to the customer, or through distributors and retailers. In effect the product goes to the customer. In a services context the customer often comes to the service provider for satisfaction. In this sense Promotion of the Offering is vital activity that must take place. Communicating the benefits of advantages of your offering is one of the main functions of marketing. The concept of VCA Promotion is that the quality and value created at the Creation stage directly impacts on the actual performance of the Promotion stage. In this sense also the organisation should look to combine and mobilise the customers themselves them into contributing to offerings. By involving students in the activities of the university they are able to create value for themselves and the organisation.

As an example, in co-operation with the technology development and Value Adding support activities, promotion can be done in a far more creative and an effective way. If the university has the design and media courses, students who completed such courses could work together on the advertisements and posters or online advertisement for the University. This way the university

will have a fresh, new, young perspective and at the same time will be able to cut costs on hiring the professional designers. It can also advertise the University as the one which gives freedom and space for creativity for their students, as well as trust, in order to create a more unified, creative and new environment for design and media students, who would also gain certain work experience for their future employment.

Delivery

The delivery stage can be described as the critical stage for a university or any service related industry. It is at this stage where the closest interaction with the customer takes place. All the expenditure of resources previous to this was for the purpose of providing a concept of value appreciated by the customer. Now the organisation has the opportunity to deliver. It is here where the main experience and shaping of perception for the customer takes place. This stage in the case of a structured learning environment such as a 4 year progression to Masters Course can be an extended and intimate activity between the organisation and the customer.

The value concept for a private university at this point could be described as aiming to provide a unique, differentiated service. Using custom tailored teaching styles to match the learning styles of students. Adopting embedded research and interactive case studies with actual organisations. Emphasising the need for a kinaesthetic practical approach to university study, where the aim is not to provide a degree, but to provide the customer with abilities and knowledge to improve the quality of their future career choices. In this sense the creation of a learning culture where interaction and learning are mutually supporting can only take place in an organisation that allows knowledge to flow freely.

Intelligence and research

In a service orientated market, knowledge of the customer's needs and wants are pivotal to success. Again this is not an isolated function of marketing that simply feeds information to the decision makes. In a market focus organisation the function of customer knowledge is at the heart of all decisions. The VCA allows for linkages to be developed across the organisation, so that changes in the needs and wants can be identified, analysed and acted upon immediately.

Coordination of support activities with this stage can produce results such as Alumni groups, tracking systems of past students in order that their success can be communicated through Promotion (see LSBF brochure). Questionnaires and surveys could be used to assess impact of delivery to current students. Effectiveness of Promotion must also be analysed. All this information is then fed back into the organisation at the Value Input allowing more informed decisions to be made as the cyclical nature of the model allows for a continuous improvement cycle. This is also a stage at which after the actual graduation and accreditation of the student,

the university using its contacts and partners can assist students with the process of finding a job. Whilst teachers can simply write reference letters to future employers, the University can formalise this process and make it part of the overall improvement of the service delivered. Another activity which can be supported with the

Value Adding Unit and Technology development can be creating online Alumni groups, where all the graduates can stay in touch with each other, in some cases working together and sharing work experience; as well as organizing yearly meetings for the graduates, where they can talk, share ideas and knowledge.

Conclusion

Porter's concept of the Value Chain is still one of the most influential conceptual models influencing business decision making today. By adapting it to a services industry and adjusting the descriptors this new model should more accurately be able to demonstrate the generic activities that go on within a company. Competitive Advantage can only come from a conscious coordination of activities with common and shared goals of customer satisfaction. Linking the VCA for services with a market focus approach can enable an organisation to make informed decisions about the internal governing of the organisation. Value Chain concept cannot work with the traditional administration

structure of an organisation. Barriers to decision making and communication in this type structure do not allow for a market focus approach. Piercy states that market focus organisations should not structure themselves around product but around the market and the customer. In this approach The VCA model can be used to assist in restructuring an organisation in order to maximise knowledge transfer internally. Whilst the traditional departments can still be maintained, the use of cross functional teams based around the support activities can assist the value being created at the primary stages. The linkages between activities can be improved as well.

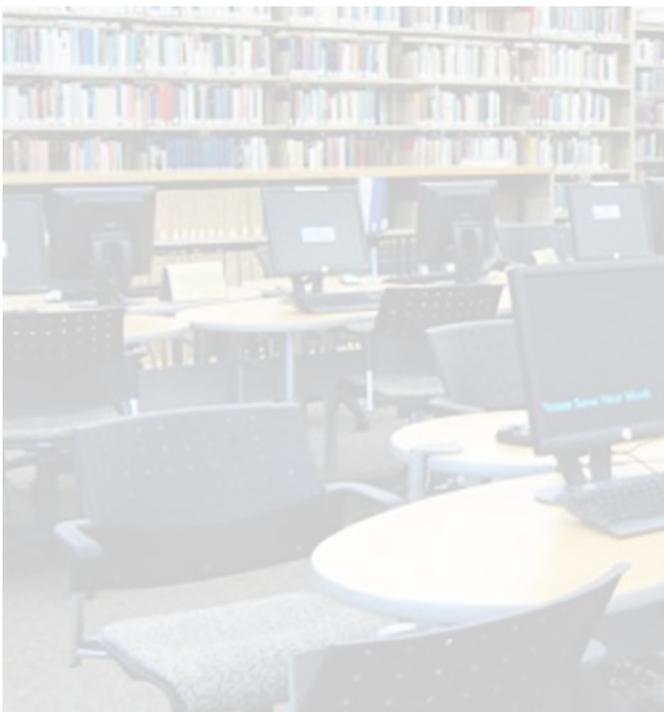
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Andy Cousins (School of Business)

Part V:

Educational matters



The main aim of this section is to allow educators a forum to explore and promote discussion on contemporary issues in education. It is also designed to allow students in higher education access to debates on contemporary education and give them the ability to apply these lessons to their own studies .

In this issue the focus will be on students and research, discussing common errors and the psychological reasons behind them. As students at all levels of post-secondary education are expected to conduct research on a variety of topics, there is a need for them to be aware of some of the pitfalls that they can encounter, the reasons for them and to see possible alternatives to avoid them.

Student Research and the use of the Questionnaire

Introduction

For any student undertaking research, one of the most common and highly utilized tool, is that of a questionnaire. It is therefore quite surprising to read student self-reflection and the work they have carried out to see major errors in the construction and use

of the technique. These errors not only have a negative effect on the quality and reliability of the research, but also adversely affect whether data can be collected and the impression a respondent has of the student researcher.

A Questionnaire

For some reason, many students see the use of a questionnaire as an easy and less demanding form of conducting research than other methods. As a consequence, less attention is given to its creation and use which often has a negative impact on the quality and utility of the information gathered and similar consequences for the outcome of the research. However, despite this impression that many have, a questionnaire must have as much thought, time and energy devoted to it as any other form of research. To not do so, is not only to misunderstand its use and function, but to misunderstand the benefits such a method can give the researcher.

A questionnaire can be defined as a method 'of collecting responses from a large sample prior to quantitative analysis' (Saunders, Lewis and Thornhill, 2007, pp 355). Each respondent is asked to answer the same set of questions to allow for comparison and the identification of trends. As Judith Bell writes (2005, pp 14):

"Surveys can provide answers to the questions What? Where? When? and How?, but it is not so easy to find out Why? Causal relationships can rarely, if ever, be proved by survey method. The main emphasis is on fact-finding, and if a survey is well structured and piloted, it can be a relatively cheap and quick way of obtaining information."

However, it is not a stand-alone method but one best used in conjunction with in-depth interviews to gain a much deeper understanding of an issue, to answer the Why? Yet, not only is this salient fact often forgotten by researchers who try to base their research simply on one method, but their research is further compromised by inadequate preparation of the questionnaire itself. Therefore, the following discussion will look at some of the most frequent errors committed in constructing and using questionnaires.

In order to highlight these common errors, the example below of possible student research has been formulated to give focus and allow discussion.

Aim: to investigate bullying in the workplace

Objective 1: to compare male and female experience and response to workplace bullying

Research Questions: Is workplace bullying a real phenomenon? What form does workplace bullying take? Is the incidence of workplace bullying related to sex? How do individuals react to workplace bullying? What are the physical and emotion costs associated with workplace bullying, if any? What measures do employees implement in the face of bullying?

Meeting the aims of Research

A recurring error in student research is the discordance between the aims and objectives of a project and the data collected from the structured interview. The following is a typical example.

Are you male or female? Please state your sex? M () F ()

This is an important question to ask as the data received will aid in the answering and fulfillment of the first objective. The problem lies then with how the researcher uses the information. To use it correctly, the researcher would separate their responses by sex and provide a comparative analysis of the results.

For all the questions that followed, it would be a simple matter of comparing the responses between men and women to see the situation facing employees at work. However, this is not always the case in student research and rather than asking the question as a tool of analysis, the question is used without thought and communicates nothing, other than the fact that the question has been asked. Having a graph that shows that fifty males and fifty females were questioned communicates only one fact, that there was an even number of people questioned. It does not aid in fulfilling the objective and therefore fails to help reach the aim of the research.

This failure to use the information from the first question as a tool of analysis, means that the following questions do not have their potential maximized and what could have been extremely useful and revealing research is simply a shallow investigation into the problem. Whilst it might indicate the incidence of workplace bullying, it does not aid us in learning if it is a universal phenomenon or is influenced by the sex of a person. Therefore, our research and the conclusions we draw from it are hampered by inadequate information.

This stems from the researcher either misunderstanding or forgetting the aims of the project and what kinds of information are required and how to use this information. There are basically two problems here, Requirement and Use.

Requirement and Use

It must always be in the mind of the researcher exactly what it is they are trying to do, what they are trying to answer. A common error for researchers is that in the process of creating their questions, they allow their topic to digress into areas which are not directly relevant to their core research. The end-result is often information which would fulfill the requirements of a different topic. In order to avoid this problem, two exercises are extremely useful for the researcher. The first is that when the questions have been created, to look at every question and justify its inclusions. For each question it is necessary to answer the following sub-questions:

Does the information gathered from this question give me a better understanding of the subject I am researching?

How does the information gathered from this question allow me to fulfill my objective and thereby the aim of the project?

Does the question provide me with new information or is it merely repetition of an earlier question?

Is the question necessary, would it affect my understanding of the subject if it was not included?

Is my question 'need to know' or 'nice to know'?

And finally at the end of the creation period, a final question should be asked, does my questionnaire provide me with all the information I require to fulfill my objectives?

Through this process it is possible for the researcher to see whether what they have created genuinely helps them or not. A common theme that runs through student self-reflection is that they wished they had asked more relevant questions or had asked for information of greater depth. The root cause of this is often lack of thought and consideration during the initial phase of creating the survey. Of course, it is possible to go through this process and still make mistakes, omit questions, ask for irrelevant information, have mistakes in presentation etc.

Therefore, it is essential to pilot the questionnaire. This much neglected step is of great importance, not only in seeing whether others can understand the rationale behind our questions and whether they have utility in answering our objectives, but also can spot errors in presentation and organization which may have been overlooked.

The second step is to choose a small sample of respondents and gather an initial set of responses. From this, the student researcher has the opportunity to look at the gathered information and see plainly whether it aids them in their objective, if anything is missing or if there is cause for misunderstanding on the part of the respondent. If this process is fulfilled, then there

is greater likelihood that the questionnaire will serve its purpose and aid rather than hinder the researcher in their aims.

Nice to know

The following is an illustration of not following this process correctly, or at all.

If we return to our research topic, it is possible to illustrate another common error, the inclusion of 'nice to know' instead of 'need to know'. After the question asking the respondents sex, another frequent question to follow is the age of the respondent. Firstly, there are issues connected with how this question is asked as there is a possibility of upsetting a respondent through poor choice of age category, but more importantly, there is the issue of whether this information is actually necessary. Our objectives and research questions make no mention of need for this information, therefore why ask it? How does this question fulfill the objective that we have set at the beginning of the research paper? It does not. It is an example of 'nice to know', but is not necessary for our study unless we change the information requirements and parameters of what we are investigating.

Should the researcher do this, then other issues have to be considered for this information to be used for a purpose rather than merely 'decorating' our study. If our first question is about sex, our second about age, then how are we to use this data? The most appropriate in this case would be to divide our responses by sex and then the male and female division by age grouping. Of course, this could be extremely invaluable information and would aid our understanding of our changed requirements. However, not only does it require a great deal more analysis, it also changes the requirements of the structured interview and how we conduct it.

For any meaningful information to be drawn, the male and female ratio would have to be the same as would the number of respondents in each age category. Comparing 26 women in the age range 20-29 to 3 women in the age range 40-49 would be a pointless exercise. How can any meaningful information be concluded from such a disparity in sample size? Therefore, if the student researcher wishes to use their gathered information to draw conclusions with any hope of reliability they would have to ensure that, not only did they interview equal numbers of men and women, but have to ensure that all age ranges are equally represented – a much more challenging task.

The result of 'nice to know' has therefore had a twofold effect on the research, to change the parameters of the research and to make data collection a great deal more challenging. Therefore, as a student researcher, again it is clear that clarity is needed in deciding the parameters of the study and ensuring that information which is gathered is directed to that purpose without digressing into, what is probably of great interest, but territory outside of the study.

Wording

Another issue which frequently occurs in student research is that of confusion on the part of the respondent and inaccurate responses to questions caused by poor choice of wording. Many of the students at the institution where I work are not native speakers of English, however, this does not preclude from research questions being well written and clear to the respondent. The most important thing to consider is whether the respondent can actually understand the question being asked. Poor choice of words, use of jargon, overlong questions and statements can all negatively influence the ability of the respondent to answer accurately. Consider the following questions:

In your opinion, does a harsh word from your immediate supervisor/manager negatively influence your ability to perform your allotted duties to the satisfaction of your own personal wishes and those of the institution/organization for which you work?

Whilst the English is grammatically correct, the spelling correct and it is relevant to the subject being researched, the opportunity for misunderstanding or confusion is vast. The question assumes that everyone answering this question has a large word-power and has a uniformly high level of education. Not everyone has. If you are looking for a highly educated audience, you are again adjusting the parameters of study and excluding the contribution of those who may not have had an equal opportunity for formal higher education. By discriminating on education, you are again losing the opportunity to study your subject in depth. If you are to ask this question, many would think it better to express it in the following manner:

Does criticism at work negatively affect your work performance?

At a glance this would appear to be a suitable question, but there is one issue which will affect the results of your study and negatively impact on you as a researcher – you are influencing the respondent. By using the word ‘negatively’ you are creating in the mind of the respondent the feeling that criticism is negative, they will think of any criticism they have had and immediately associate it with a negative connotation. Naturally, they will then answer yes to the question. You have in effect forced them to give an answer in line with the preconceptions of the researcher and rather than understand the effect of workplace bullying, have simply reinforced your own feelings.

Therefore, it is vital that our questions do not create associations; we do not use presumption so that we get the answer we feel as right. Nor should we ever lead the respondent to conclude with an answer they do not actually believe in. The following, taken from an episode of *Yes, Prime Minister*, a British comedy, perfectly illustrates this in action.

Sir Humphrey Appleby – Mr Woolley, are you worried about the number of young people without jobs?

Bernard Woolley – Yes

Sir Humphrey Appleby – Are you worried about the rise in crime among teenagers?

Bernard Woolley – Yes

Sir Humphrey Appleby – Do you think there is a lack of discipline in our comprehensive schools?

Bernard Woolley – Yes

Sir Humphrey Appleby – Do you think that young people welcome some authority and leadership in their lives?

Bernard Woolley – Yes

Sir Humphrey Appleby – Do you think they respond to a challenge?

Bernard Woolley – Yes

Sir Humphrey Appleby – Would you be in favour of re-introducing National Service?

Bernard Woolley – Well, I suppose I might

Sir Humphrey Appleby – Yes or No

Bernard Woolley – Yes

Of course, after answering ‘Yes’ to all the previous questions, Bernard would look foolish if he now answered ‘No’. Sir Humphrey Appleby as a researcher has simply directed Bernard to the response he wanted. Whilst it may confirm his own feelings and prejudices, it is not ethical behavior on the part of the researcher and the value of the research is nil.

In order to avoid these traps then, much attention must be paid to our use of words and phrasing. According to Judith Bell (2005, pp138) there are several things to consider:

Imprecision and Vagueness – You ask a question to your respondent such as ‘The company provides adequate reporting mechanism’s for cases of bullying and harassment’. The responses you give them might be ‘Excellent, Really Good, Good, Adequate, Bad, Very Bad, Terrible’. The problem here is that what is the difference between ‘Really good’ and ‘Excellent’? How do we define the difference and do all people have the same definition? Probably not. Therefore, whilst someone might answer ‘Excellent’ and another ‘Really Good’, both were intending to express the same sentiment but have different ways of expressing it. By choosing different options your data is not a true reflection of the respondents views on the question and your data is therefore unreliable. Yet before this, there is another problem, that of the question itself. You use the word ‘adequate’, but what does it mean? Do you and the respondent understand the word and its implications exactly the same, probably not. Words have power, often negative, and a poor choice of words has the power to negatively influence your research.

Making Assumptions – You ask a question to your respondent such as ‘Where does your spouse work?’ Here there are two assumptions being made, one, that the respondent is married, secondly, the spouse works. What if neither of these is true, they don’t have a spouse or the spouse doesn’t work, how do they answer the question? In this kind of situation, the respondent would most likely leave the question blank unless you had provided options to choose, but even this is a problem as by providing a box labeled no spouse and assuming they have spouse creates an discord between

the two. It must be remembered that you want people to answer and also to have the feeling that you are professional as well.

Memory – You ask a 55 year old employee the question ‘Did your boss treat you fairly in your first job?’ Not only is this an imprecise question but a test of someone’s memory. How likely is that someone after probably working for the past 35 years has a clear memory of their first job and their first employer after that amount of time. Not much. If you are really interested in what someone did a long time ago, you would have to be more specific and choose themes that they are likely to remember, their position, salary etc. However, the problem is whether this is relevant to what you are researching. In this case it would be better to remove the question as the responses you are likely to get will not be in any way considered accurate or reliable.

Double Questions – A question such as ‘Have you ever been bullied or sexually harassed at work?’ is going to give the researcher real problems to analyze. If they say ‘No’, they are indicating that neither have happened. The problem is when they say ‘Yes’, because you may have three possibilities and then you don’t know which one as a researcher is the true one; the first the second or both. The simple answer, ask two separate questions.

Saunders notes (2007, pp 355), ‘you are unlikely to have more than one opportunity to collect the data...you will be unable to go back to those individuals who chose to remain anonymous and collect additional data using another questionnaire’. If the researcher does not, as sadly many student researchers do, their work will suffer from flawed and incomplete data and therefore flawed conclusions.

Conducting a Questionnaire

For conducting research using a questionnaire, there are many options available which can be utilized in gathering the data. However, just as the questions need to be formulated carefully, so does our manner of data collection.

Facebook

Since the advent of social networking sites such as facebook, there has been a tendency amongst student researchers to utilize this resource in their research. Whilst this is no bad thing, social networking sites can present the researcher with an extremely powerful search tool, thought must be applied to its use. Returning to our theme on bullying in the workplace, it would be a simple matter to send a link to a survey to all our friends and wait for them to fill it in. After all, they are our friends and most likely want to help us. Yet, here again we are going to have problems. A typical student researching their dissertation would be between the ages of 21-25, the chances are that the majority of people who are our friends on facebook will be of a similar age. If we are looking for information on bullying, there is an issue here. Whilst many people

by the age of 25 will have work experience, how extensive is this knowledge? Does someone with a part-time job stacking shelves at a supermarket at weekends have the same insight as to someone who works full-time? Perhaps, but it cannot be taken for granted and this potential for error can cloud the conclusions we draw. Unless we are specifically looking at young people with under five years work experience, it is not possible to use this to make sweeping conclusions as to bullying at work. Again, we would have to change the parameters of our study.

To highlight this, I would like to offer an example. The author of this paper is 36 years old and has 170 friends on facebook. Some of these people are my peers so there would be no trouble collecting information on the are range of 30-39, many of my friends are students of the institution where I work, most of whom are between the ages of 18-25, so no problem, here. The problem lies in trying to find information from people older than myself, of whom few are listed as my friends on facebook. To be rigorous in my research, this would prove quite an obstacle.

Naturally there are ways around this problem, I could of course ask my friends to pass on the link to all their friends, colleagues, family etc in the hope that I would be able to gather enough people in each age range of my study in order to draw conclusions. However, this is not guaranteed. Firstly, it is hard to expect every single one of my friends to take the survey. Secondly, being sent the link of someone you don’t personally know may preclude them from answering the survey as well. Lastly, How does the researcher ensure that the responses are accurate and really reflect the opinions of the respondents? This is of course an error with all structured interviews, there is always the possibility of unreliable information, but seeing as facebook is perceived to be a fun network, is it possible that everyone has completed the survey accurately or treated it as a bit of fun? As a researcher, you are not allowed to pick and choose the responses you use, so therefore reliability and validity could possibly become an issue should someone find it amusing to communicate a tale of tragedy and woe, the truth of which would lie in the realms of Harry Potter fantasy.

On-line surveys

The internet is an incredibly powerful research tool, if used with thought and circumspection. There are a great number of on-line tools available for the creation of structured interviews which will collate data and present you with a summary of responses. Often these are presented to a specific on-line community which partake in surveys, at face value making research easy and convenient. However, sometimes it can be ‘too good to be true’. What is the motivation for these people to partake in such surveys, are they being paid, are they bored, do they have a genuine interest in your subject, do they have experience and knowledge in order to assist your research?

Lastly, will they take it seriously? From the experience of teaching research skills over the years and observing the use of such tools by students, it is possible to conclude that it is a lucky student indeed who gets a return worth considering. No response, incomplete responses, irrelevant responses are quite common and a reliance on this model of research is truly playing with chance. This is not to say that they are a complete waste of time, but they are perhaps best used in conjunction with other methods to ensure the researcher is able to gather information of use to their study.

Direct email

This would seem to be a most suitable method of data collection, going straight to the horse's mouth for the information required for our study. Emailing our contacts or employee's would seem to be an excellent method. Yet here again, there are issues to be considered. Firstly, do you know enough people and have their personal information in which to do this effectively? If yes, then again you are open to receiving one-sided information as already discussed in using facebook. It might be the case that a friend or colleague forwards your message onto all their colleagues to target more respondents. However, there are several issues to consider. If you are sending emails to people, bulk emails and personal emails often get consigned to someone's work spam box. It is a rare person indeed who checks their spam box. A second consideration, is that people at work are often far too busy to fill in a survey, when pressing deadlines, the report for the manager is due. It is only necessary to think of how you treat the offer of taking a survey on a site like Yahoo, how often do you take them when you are instead trying to keep in touch with your friends or catch up on the latest news? These factors can have a negative impact on the amount of response you get. Sending out 40 emails and expecting 40 responses is an exercise in wishful thinking. Unless you are extremely lucky or incredibly popular, a response rate of one in five is perhaps the best you can expect.

You may be in a position that you can simply email all your colleagues or have the opportunity to have the Human resources Department of your company send an email to the employees of your company. Simply sending an email to all your colleagues in the company database may seem quite easy and effective, but it may land you in deep water with your boss or the HR department, especially if the questionnaire is on a subject such as bullying. Colleagues may not have considered such a thing before, with your questionnaire being sent through official company channels, employees may believe it is officially sanctioned (great for you it would seem) but start thinking of bullying more and within a few days the human resources department is inundated with complaints about bullying and you may find your employment terminated quite quickly when traced back to you. Even if you approach the HR department, there may be a refusal to sanction

your work. Companies are rather sensitive about such matters and finding out that the company is seen as a bully through the press who have read your research may not impress them. Instead, the benefits to the company must be stressed, access to all data and conclusions must be given and anonymity guaranteed if it is to be successful at all. Even then, permission can and often is refused so someone pinning all their hopes on this method may be disappointed.

Face to face

A tried and tested method is simply to go to the street and ask people in person. This has the advantage of being able to target people in the ranges you want. If we return to our changed study on bullying, we would be able to select people based on their sex and apparent age and it would seem be able to gain maximum benefit for our investigation. Yet even here, there are potential problems for the researcher. Again, it must be realized that people are busy, they may be in a rush to get to the office, to get to the nursery and pick up their children or simply have no time for you. Here is the problem: a lot of people will not answer you. Therefore, this method can be extremely time consuming especially if one targets the wrong respondents. Unless you choose the time and respondent carefully, the people who answer you may have no experience of your subject. After all, how can an elderly woman who has been a housewife her entire adult life, give you valuable data on workplace bullying, except through anecdotal and second hand experience. If you choose your respondents carefully, you can of course get the people you require, but it can take a long time to gather a sample on which to base your research, especially if you a sole researcher.

A further challenge to this method, is again, reliability. Whilst it is fairly straight-forward to ascertain the sex of a person, age is another matter entirely. It must be remembered that people can be very sensitive to personal questions and the answer they give you may be very different to reality. Experience can also be a touchy subject, people do not wish to look foolish or weak so touching on sensitive topics such as bullying in the workplace again may induce the respondent to say something quite far removed from reality, the quality of information you receive thereby negatively affected. One way to overcome such inhibitions is to allow the respondent to simply tick off boxes, which allows them the opportunity to answer honestly without feelings of embarrassment or weakness. Yet this takes time, the subject is sensitive and it may be some time before you have a sample size adequate for your research.

Conclusion

So what can we learn from all of this? The most important fact to remember is that a structured interview is a powerful research tool and for a student looking for quantitative data for their research, then it is ideal. However, the researcher must exercise caution and thought when using such a method. It is far

too easy to make elementary mistakes with this research tool and unless the researcher is fully focused on their subject of research and thinks clearly of their information needs, then this method has the ability to generate a lot of waste - time, effort and research opportunity.

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Dave Gannon (School of Bussines)

Cognitive processes of student researches



Introduction

When we think about research, one of the most important factors that come to mind is that the author is objective. As we will see in the following discussion, it is not always easy to stay objective and come to well analyzed conclusions, even if we try. It is often easier to see our errors in retrospect and learn from them than to get ourselves organized enough, in terms of time and content, to get it right from the beginning. This paper aims to recognize some of these difficulties students encounter when doing research from a psychological point of view and explain why they occur as well as identifying some strategies to help them overcome these cognitive barriers. The cognitive perspective of psychology focuses on the study of higher mental processes. More specifically, it analyzes the way people think and act 'based on the assumption that thoughts intervene between events and our emotional reactions' (Myers 2002, p. G-2).

Cognition can be defined as the way people think, know and understand the world around them. (Feldman 1987, p. 15) Therefore, if we want to look at how students conduct research and why they make the common mistakes they do, we must understand the cognitive processes affecting their thinking and consequently

behavior. More specifically we are interested in how students process new information and identify possible misinterpretations of new information as well as limitations of such cognitive processes. People, according to Pendre, (2008, p.68) process information on a daily basis on two distinct ways:

- Automatic process: fast, effortless, unintentional
- Controlled process: precise, effortful, intentional

While the automatic process is absolutely essential to the survival, adaptation and development of our species, student researchers want to avoid this kind of thought process as it is often associated with rash judgments and spur of the moment conclusions. While it is important to identify how and why people often process information in this unintentional way, the main point will be to understand how this cycle can be broken when concentrating on producing objective research questions and analyzing the data collected.

Turning on the automatic pilot: Jumping to Conclusions

When we think about the amounts of information that we receive on a daily basis, from simple sensory stimuli to complex subject-specific information, it can seem quite overwhelming. Therefore our brains have constructed a system in which to organize this information and make it meaningful for us. This process of allocating people and objects into distinct groups is called categorization. This simplification of information makes us view the world as a more orderly, predictable and controllable place (Pendre 2008, p. 70). Once we have placed a certain object or person into a category, we then activate the content of this category which is termed schemas. Schemas refer to our expectations of the people and objects in that category and essentially what defines them for us. It includes all the predigested information which we have collected and learned to associate with that category over our lifetimes. According to Pendre (2008), the next step in this automatic process is to apply these schemas by looking only for information that is consistent with our expectancies, thereby confirming the stereotypes of that group. In this way we link our previous knowledge structures and existing beliefs (schemas) to new information (Pendre 2008, p.73).

This is often observed by lecturers, for example, when students are creating surveys using this automatic process and jump to the conclusion that a survey must include information about gender and age without those two factors even being relevant to their research. By doing this they automatically applied their schema or expectation of what a survey should include, applied it to the stereotype of a survey without thinking if the

information is relevant or not.

To understand the power of automatic processing which is unconscious and does not require any intention, attention or effort, one must realize that any time the appropriate cues are present stereotype activation is invariable. While it is often a useful strategy to jump to the first obvious conclusion it is not always a good one, especially when doing research which is meant to be as objective as possible and to stay clear of stereotypes in any way.

Turning off the automatic pilot: Regaining Cognitive Control

Although it may seem from the above explanation that the activation of stereotypes (schemas) is inevitable, there are in fact strategies to prevent us from unconsciously jumping to conclusions. Although a schema may have already been activated, there are a number of strategies to prevent us from responding in a stereotypical way. However, this is only possible, as Fiske (1989) argues, if the following essential criteria are met:

- We must be aware of the potential influence of stereotypes.
- We must have sufficient cognitive resources (in this case primarily attention and time) in order to exert control.
- We must be motivated not to respond stereotypically.

In the case of student research in which students should restrain from automatic processing we can make the following suggestions. Firstly, it is important for students to understand the process described in the first section about the vast impact of stereotype activation on our cognitive processes. Simply being aware of the potential that our schemas can influence our thinking in such a drastic way, can prevent us from making the wrong assumptions or jumping to incorrect conclusions. Second, it is important for them to pay close attention to every step in their research not to make rash judgments and unintentional conclusions. It only takes one mindless/careless mistake which was a result of the lack of attention and the entire research can be completely biased. In order for students to be able to work on the preparation, writing, and analysis of data so thoroughly, it is crucial for students to allocate enough time to the preparation of their research as this significantly reduces the risk of automatic processing. Lastly, the student must be motivated to process information systematically. This can be achieved in various ways. One factor that certainly should motivate students to be more cautious about their cognitive responses is the accountability factor. This means, according to research done by Fiske (1987) and others, that individuals who have to justify their responses to a third party and held responsible for their responses, judgments and conclusions should show less stereotypical thinking. In addition, perceivers who are instructed to be as accurate in their responses as possible are more likely to be motivated to process information systematically. Again, in the case of students this should be an evident factor. It is important to understand that all three of

these crucial criteria must be met in order to minimize automatic processing. If, for example, we are motivated to avoid stereotypical thinking but lack the time or attention, our ability for systematic processing is reduced (Pendre 2008, p. 80).

From the explanation above we can see that things are not as clear-cut and that many factors influence to what extent we process information automatically versus systematically. According to Pendre (2008) the continuum model of impression, depending on our level of interpretation, motivation and attention, we form impressions on a scale ranging from spontaneous, quick, effortless decisions (category based evaluation) to thorough, effortful, and conscious responses.

Further, to avoid stereotypical thinking it is not simply enough to suppress the stereotypes. Studies show that "the more we try to suppress stereotypes, the less successful we will be." (Pendre 2008, p. 81) This is due to a process called priming. We are primed to think in a stereotypical way when we are exposed to outside cues or stimuli which in turn activate a certain schema. For example, when students search for survey samples on the internet which they could use as an example for their own survey, they are primed with a "survey stereotype". Then, even if they follow the three steps highlighted above, there is still a risk for them to activate the survey stereotype, even if they try to suppress it, as the priming has caused the stereotype to become hyper-accessible for them (Pendre et al. 2008, p. 83). If then in fact simply thinking about a schema only strengthens it and commits us to holding it even more, it is crucial that we reconsider our old schematic beliefs to see if they are still applicable in sight of the new information. This is important because having incorrect or inaccurate schemas can lead us to fundamental errors in judgment.

Additional factors that strengthen systematic cognitive processes are self-focus and individuation. Therefore, when students are conducting research in a certain area, they must think about how and why their particular research will be different (or individualistic) from research that has been done in the past about the particular subject matter. This will help them to process the new information more systematically as opposed to automatically. Further, studies performed by Dijksterhuis et al (2000), have shown that the simple act of sitting in front of a mirror when writing an essay about a politician, subjects have shown to refrain from stereotypical thinking unlike subjects who have been shown a picture of a politician before writing the essay. Therefore under conditions of self-focus students might be able to avoid stereotype activation and be able to better identify their own individualistic approach and engaging systematic cognitive processes as opposed to automatically jumping to conclusions.

Conclusion:

From the above discussion we have learned how difficult it is in fact to shut off our automatic cognitive processes and to not simply jump to the first obvious explanation which has been primed by outside stimuli. The extent to which students engage in systematic processing depends on their awareness of the existence and magnitude of stereotypes as well as the relationship of the students' attention and motivation. Though one would think that producing a brilliant piece of research would be motivating and rewarding in itself, the reality is that many (especially younger) students do not see it this way, particularly during the production process. Therefore it may be beneficial for them to also know that a quality dissertation

has the potential of being published or displayed in the school's student portal, etc. However, as mentioned above, motivation alone is not enough to bypass the automatic processing. Students must pay great attention to detail at each step along the research development which in turn requires adequate time management. As a practical suggestion, it may be beneficial to students to divide their research into specific sections, targets and goals and define them as clearly as possible. Finally, perhaps the most effective way to reduce stereotyping when producing research is to have numerous people proof-read the student's work thereby minimizing stereotyping and maximizing objectivity.

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Anna Boguszak (School of Business)

Prague College
Polská 10
120 00 – Prague 2, Vinohrady
Czech Republic

Tel.: (+420) 222 101 020
(+420) 222 722 544
Fax: (+420) 222 718 813

info@praguecollege.cz

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