# The Evolution and Emergence of QR Codes

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*This book is fondly dedicated to my late father İlyas AKTAŞ*

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# PREFACE

In the process of expansion in areas of communication and the improvement of possibilities in society, communication technologies and the new media constitute an important and effective medium. The potential of communication technologies and the new media characterized by digitalization, networking, globalization, mobility, convergence and interactivity facilitate social participation and interaction in the social dimension, provide storage facility in the time dimension, offer mobility and the possibility of global spread in the space dimension and offer an opportunity to benefit from multimedia in the sign dimension. The opportunities presented by communication technologies and the new media have become an important part of daily life. Communication technologies, which have become definitive in the fields of economics and commerce with the digital culture they constitute, offer individuals relatively new and independent use of the media. Within this framework the QR Code (Quick Response Code) has become increasingly important in the usability of means of communication.

The QR Code facilitates connection between real objects and designed contents and enables various uses. Originating from the Japanese automobile industry, the QR Code is used in many fields including culture, art and tourism as well as in daily life. Using the QR Code, contents with a designated attribution can be stored and used in a required place and with certain objects. In this way, a new connection can be made between real objects and the contents of the Internet.

In the development of communication technologies and the new media, while economics plays an important role, it in turn is also affected by this field. Communication technologies and the new media are also having an effect on culture. The use of analog and digital communication technologies together, as well as hybrid communication technologies, has brought about the emergence of new media and the meeting of global and local cultures in the process of globalization. Despite the pressure of dominant cultures on local cultures, the capacity of local cultures to resist the dominant cultures creates hybrid cultures.

With his book entitled *The Evolution and Emergence of QR Codes,* Celalettin AKTAŞ becomes a pioneer in QR Code research by investigating this subject, which is increasingly important in the world and which is little known and has not been adequately researched in Turkey.

The importance and value of this work results from its investigation of the QR Code, communication technologies and the new media within the framework of their technical and economic foundations, and from its indication of the areas in which the QR Code is used and the limitations in its use. Moreover, it formulates solutions for extending the areas of use of the QR Code. This book provides an opportunity to interpret the spread of the QR Code from a broad overview, investigating its use together with analog and digital communication technologies within the framework of the tendency towards the hybridization of communication and media technologies and social culture and the effects of such hybridization. In the field of communication science studies in Turkey, I believe that this milestone containing fundamental information will provide an introduction to the subject for scholars, students and others to begin to comprehend the subject.

Prof. Dr. Füsun ALVER

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Prof. Dr. Celalettin AKTAŞ

# ABBREVIATIONS

**1D Barcode:** One-Dimensional Barcode
**2D Barcode:** Two-Dimensional Barcode
**3D:** Three-Dimensional
**ABD**: Amerika Birleşik Devletleri (English: United States of America)
**AIM:** Association for Automatic Identification and Mobility
**BTK:** Bilgi Teknolojileri ve İletişim Kurumu (English: Information and Communication Technologies Authority of Turkey)
**CAGR:** Compound Annual Growth Rate
**CD:** Compact Disc
**CEO:** Chief Executive Officer
**DARPA:** The Defense Advanced Research Projects Agency
**DVD:** Digital Versatile Disc/ Digital Video Disc
**FT:** Financial Times
**GPRS:** General Packet Radio Service
**GPS:** Global Positioning System
**GSM:** Global System for Mobile Communications
**HTML:** Hypertext Markup Language
**IAB:** Interactive Advertising Bureau
**ICT**: Information and Communication Technology
**IEC:** International Electrotechnical Commission
**ISO:** International Organization for Standardization
**JAMA:** Japan Automobile Manufacturers Association
**JIS:** Japanese Standards Association
**MNO:** Mobile Network Operators
**OMA:** Open Mobile Alliance
**ORF**: Österreichischer Rundfunk (English: Austrian Broadcasting Corporation)
**PDA:** Personal Digital Assistant
**PwC:** PricewaterhouseCoopers
**QR Code:** Quick Response Code
**SMS:** Short Message Service
**TL:** Türk Lirası (English: Turkish Lira)
**TÜİK:** Türkiye İstatistik Kurumu (English: Turkish Statistical Institute)
**UNICEF:** United Nations Children's Fund
**URL:** Uniform Resource Locator
**US:** United States

**USA:** United States of America
**USD:** U.S. Dollar, or American Dollar
**VCD:** Video Compact Disc
**VNI:** Visual Networking Index
**WAP:** Wireless Application Protocol
**WWW:** World Wide Web

# INTRODUCTION

Developments in communication technologies and media have transformed social life in many ways, from people communicating with each other to media consumption trends. People have begun to prefer the new media compared to traditional communication technologies for gaining access to information, conveying information and communicating with each other. Nowadays, as compared to the old times, people communicate less with one another using traditional mail. People do not send postcards when they visit a place; they hardly use greeting cards during holidays or when celebrating special occasions; they rarely use printed encyclopedias to access information, and they seldom read traditional print newspapers and magazines to learn about events around them and in the world. Arzum Meleksoy, Istanbul Office Director of United Nations Children's Fund (UNICEF) Turkey National Committee, "Tebrik Kartları Teknolojiye Yenik Düştü" (*Sabah*, October 12, 2013) states that greeting card sales have been declining in the world, but this trend has been observed more sharply in Turkey. Meleksoy links declining greeting card sales to the advancement of communication technologies and an increase in the use of electronic mail, social media and short message services (SMS) for celebratory messages, "Tebrik Kartları Teknolojiye Yenik Düştü". Thus, it seems that electronic mail and social media will soon completely replace greeting cards that come via our mailboxes, hand-written, signed, held in our hands, and put on mantel-pieces to be checked from time to time. The warmth of these communications will be replaced by digital codes. According to *Adult Education Survey,* "İnternet Eşi Dostu Geçti" (*Habertürk*, August 4, 2013), by the Turkish Statistical Institute (TÜİK), the use of mass communication media, such as television, radio, newspapers, magazines and posters to access information declined from 9.2 percent in 2007 to 5.8 percent in 2012 in Turkey. The use of traditional print books as a means to access information within the same period declined from 6.3 percent to 5.7 percent. The use of the Internet to access information increased from 38.1 percent in 2007 to 54.7 percent in 2012, "Yetişkin Eğitimi 2012" (*TÜİK*, July 31, 2013). Thanks to communication technologies and the new media, nowadays people are able to simultaneously access, share information and rapidly send information found in completely different formats by means of a great variety of

devices without the limitation of time and space, via one single transmission channel, the Internet.

Physical barriers to sending information from one place to another have been removed by communication technologies and the new media, breaking the bonds of time and space. Thus, these technologies have effectively transformed our world into a smaller place by providing their users with the possibility of global communication unlimited by time and space. Karl Marx refers to this phenomenon in *Grundrisse* (1973) as "the annihilation of space by time" (as quoted in Tomlinson 2004, 14), as does David Harvey (1991, 234), who refers to it as "time-space compression". This affects people's perceptions and their social organizations. The ability to rapidly transmit information by means of communication technologies and the new media creates the impression that the distance itself has shrunk because the time spent to cover it has been shortened. The ability of new media to move texts and images through time and space opens up the possibility of what J. B. Thompson (1995) describes as "intimacy at a distance" (as quoted in Stevenson 2002, 201). Negroponte (1995, 165) states "In the same ways that hypertext removes the limitations of the printed page, the post-information age will remove the limitations of geography. Digital living will include less and less dependence upon being in a specific place at a specific time, and the transmission of place itself will start to become possible." He thus emphasizes that communication technologies and the new media will remove the limitations of geography and make it possible for people to follow events in real time, even though they are not physically there when the events occur.

Furthermore, developments in the field of mobile communication technologies have also removed the obstacles to mobile data transmission together with voice communication. Technical developments in this field have transformed mobile phones, which were already primary in providing mobile communication services, into multifunctional communication devices. In fact, the devices that people carry in their pockets today are a kind of computer made possible by the achievement of voice communication. Consequently, to conventional voice communication and SMS provided by mobile phones, there has been added the release of smartphones onto the market. These have been designed to contain the functional properties of a personal digital assistant (PDA), a product from the computer world. The rapid increase in the use of these telephones, with mobile data traffic exceeding mobile voice traffic in the information and communication sector has opened the way for the possibility of developing hybrid communication media. Nowadays people do not use smartphones simply for voice communication.

According to the Cisco Visual Networking Index (2013) Global Mobile Data Traffic Forecast for 2012 to 2017, global mobile data traffic is expected to increase 13-fold over the next five years and reach some 11.2 exabytes per month (or 134 exabytes annually), and smartphones, laptops and tablets will account for 93 percent of global mobile data traffic by 2017. Turkcell Chief Regulation and Legal Officer, Dr. Tayfun Çataltepe, who spoke at the 11th Transport, Maritime Affairs and Communications Security Social Facilities Council's introductory meeting, emphasizes that around the world the focus is more on data communication than on voice communication in the mobile communication industry. In the very beginning, voice was a very important part of mobile communication, but now data has become everything and voice communication is just a part of it (Kaya 2013). It appears that mobile data traffic carried by mobile communication devices will be an important portion of mobile communication services in the coming years.

According to Louho, Kallioja and Oittinen (2006), the rapid development and use of information and communication technologies and mobile technologies has made it possible to develop new media product concepts and combinations. QR Code is also a new communication medium that provides a convergence of both digital and analog communication technologies. QR Code is a new media combination of information and communication technologies and mobile technologies. Thus, QR Code offers communication scholars new communication platforms in which digital and analog media communication technologies can be used together. Not only do digital and analog communications media exist, but also in addition to these communication media, hybrid communication media that use both technologies together also exist. Hybrid communication media are a combination of the contents and functionalities of digital media and print media.

Nowadays, QR Code can be used in a wide range of areas: commercial tracking systems, entertainment, in-store product labels, marketing, traditional print newspapers, television broadcasting, traditional book publishing and websites. QR Code can be placed in print media (newspapers, magazines, books, posters, etc.) and in different media types, such as web pages, television programmes and commercials. QR Code, as a widely used communication medium in the media industry, deserves to be studied by communication scholars; it should not be a communication medium that is only studied by engineers. It is understood that hybrid communication media within the media industry will have an important place in the coming years. This book aims to fill an important gap,

considering that no significant study concerning hybrid communication media exists. Within this book, QR Codes are examined in depth in the context of the technological specifications of communication technologies and the new media and their functional properties. The primary purpose of this book is to provide fundamental information about QR Code technology within the framework of the technical and economic bases of communications technology and the new media. The secondary purpose is to introduce the primary use and limitations of the QR Code and to suggest solutions aiming to eliminate potential obstacles to its widespread use.

QR Code technology is expected to change entirely the way of accessing and retrieving digital information. Its ability to bypass search engines while accessing and retrieving information online is a revolutionary innovation. To be able to directly access online information via traditional communication media in any place and at any time, avoiding suffocation by today's flood of information, is a matter that should be considered by communication scholars. Thus, communication media have a significant impact on social organizations and civil institutions in any society. New media change the structure of social organizations, create new forms of information and usually shift the center of political power (Innis 1986). Thus, "The medium or process of our time is reshaping and restructuring patterns of social interdependence and every aspect of our personal life. It is forcing us to reconsider and reevaluate practically every thought, every action, and every institution formerly taken for granted. Everything is changing…Societies have always been shaped more by the nature of the media by which men communicate than the content of the communication" (McLuhan and Fiore 2001, 8). Therefore, "Culture is mediated and enacted through communication, cultures themselves−that is, our historically produced systems of beliefs and codes−become fundamentally transformed, and will be more so over time, by the new technological system" (Castells 2000, 357). The QR Code, as a new communication medium, has an impact on social culture, and its influence will continue to expand. In fact, the QR Code forms a hybrid cultural structure by enabling the convergence of both digital and analog communication technologies. A tertiary purpose of this book is to examine the role of the hybridization of communication and media technologies in the hybridization of social culture.

Chapter 1 of this book focuses on the technical and economic foundations of communication technologies and especially the new media. The role of developments in information and communication technologies in transforming social culture has also been highlighted. Then, the development and transformation of communication technologies are given

in chronological order and are defined by providing brief information about the communication media. Furthermore, the characteristics of communication technologies and the new media are defined. Thus, the basic concepts of QR Codes technology have been explained in terms of communication technologies and the new media. Chapter 1 also discusses the developing trends of communication technologies and the new media, and aims to predict how they will change.

Chapter 2 of the book explains the technical and functional features of the QR Code as a form of communication technology and a new medium. Information given in this chapter concentrates on the characteristics and functional features that enable the use of the QR Code. These topics give clues to the way in which the QR Code can be used in traditional communication media.

Chapter 3 of this book focuses on key areas of use for the QR Code and includes examples. In this chapter, the use of the QR Code in traditional print newspapers, in advertising and book publishing is examined in detail. Information gathered from the experiences of organizations that use this technology throughout the world is provided. Chapter 3 also focuses on limitation factors of QR Code usage and solutions to them. It is understood that in order to increase the use of the QR Code within societies, both mobile network operators (MNO) and institutions wishing to place QR Code on their products and publications have important responsibilities to accomplish.

Chapter 4 of the book discusses the role of QR Code technology in cultural transformation. Since the QR Code allows digital and analog technologies to engage with each other, it leads to the thought that a hybrid cultural structure may occur. Thus, the role of QR Code technology in the hybridization of media and communication and the hybridization of social culture is discussed. It is obvious that using QR Code technology makes it possible to integrate traditional communication media, such as newspapers, magazines, books and digital communication technologies. Therefore, barriers have been eliminated from the use of communication media together without substituting one for another. Thus, the use of the QR Code in association with the contents of print media (newspapers, magazines, books, etc.) makes one think that people can experience both typographic culture and digital culture together. In this way, it may be possible for the presence of traditional communication media to survive in the media field in a new format.

# CHAPTER ONE

# TECHNICAL AND ECONOMIC FUNDAMENTALS OF COMMUNICATION AND NEW MEDIA

Marshall McLuhan (1964), in his book entitled *Understanding Media: The Extensions of Man,* connects leaps between stages of social change to developments in information and communication technologies. According to him, developments in communication technologies play a major role in transforming social culture. McLuhan asserts that the Pre-Writing Society was dominated by tribal life and traditional verbal communication; the Writing Society was dominated by writing and printing techniques; the Information Society is dominated by electronic communication media and appears as the global village society of our time.

In the Information Society which McLuhan envisions, information services, which consist of data banks and communication networks, would be increased, making the information industry the dominant industry and resulting in participatory democracy becoming the main political system. McLuhan believes that the missing parts of the Industrial Society would be resolved by the Information Society. According to McLuhan the people of the Industrial Society are also productive and the use of technology is becoming more widespread. However, among the people of this society the sense of belonging or sharing no longer exists. In spite of this negativity, information and communication technologies and the relationship of reciprocal interdependence they create will turn the world into a global village. Thus, people already perceive the world as smaller than it is; in the last quarter of 2014, 3 billion (40 percent of the world's population) Internet users, "Internet Users in the World" (2015) are already communicating with each other within different online communities. Nowadays people have the opportunity to synchronously or asynchronously connect with each other through communication technologies and the new media, surpassing the limitations of time and space. Thus, people have become citizens of a world that has no boundaries by feeling closer to one another. Michael Hauben (1992, para 1), who coined the term 'Netizen' and introduced it into popular use,

writes in his article entitled *The Net and Netizens: The Impact the Net Has on People's Lives,* "…You are a Netizen (a Net Citizen), and you exist as a citizen of the world thanks to the global connectivity that the Net makes possible. You consider everyone as your compatriot. You physically live in one country but you are in contact with much of the world via the global computer network. Virtually, you live next door to every other single Netizen in the world. Geographical separation is replaced by existence in the same virtual space".

McLuhan (1964) asserts that the Agricultural Revolution depended on accessibility to arable land, while the Industrial Revolution depended on a wealth of material resources or having the power to seize them; the Information Revolution may not depend on land and natural resources but on efficiency in the economy which will be created by information and communication technologies. Those who put forward the concept of the Information Society predict that socio-economic imbalances between developing and developed countries will disappear, thanks to the production, processing and accessing of information in the age of information and communication technologies.

According to author and futurist Alvin Toffler, three major waves of change have been observed in human history. Each of these largely obliterated earlier cultures and civilizations and replaced them with new ways of life inconceivable to those who came before. These transformations of civilizations are described as the First Wave of change, 'the Agricultural Revolution', the Second Wave of change, 'the Industrial Revolution' and the Third Wave of change, 'the Post-Industrial Revolution'. Toffler (1981) suggests that, in the First Wave, civilizations and human groups were forced to store their social memories in the same place as that in which they kept their personal memories, i.e. in the minds of individuals. While the Second Wave civilization radically expanded social memory, which became objectified and embedded in artifacts, books, newspapers, photographs and films, it also froze it. In the Third Wave civilization, the processing of stored data (artificial memory) through the computer expands the scope of social memory and activates it. In the Third Wave civilization developments in information and communication technologies, by increasing the diversity of the media that enable communication between humans, have resulted in machine-to-machine communication for the first time in history. More surprisingly, they have produced powerful communication media that enable communication between humans and the intelligent environment around them (as quoted in Aktaş 2007).

Another remarkable thesis of Toffler (1981) is that the dominance of mass media, far from expanding its influence, will completely disappear in the Third Wave of civilization. New types of communication media have emerged with the development of information and communication technologies and started a communication era that does not target a mass audience. According to Toffler (1981, 135), "The demassification of the civilization, which the media both reflects and intensifies, brings with it an enormous jump in the amount of information we all exchange with one another. And it is this increase that explains why we are becoming an 'information society'". When information media become varied in the Information Society, when people around us recover from massification, individuals will be more distinctive and will bear less resemblance to one another. Therefore, their need for information will be increased. McLuhan and Powers (1989, 89) explain that "In the Information Age, the computer, working at the speed of light through a myriad of communication devices, will produce tailor-made products and services for potential buyers who have already presignaled their preference through the database, whether it be a perfectly adjusted insurance/investment program or a dream vacation". Thus, they predict that society will evolve away from massification towards individuality by means of computers and new communication media.

The core technology of the Information Society is the computer. In his book entitled Megatrends, John Naisbitt (1984, 22) argues that "Computer technology is to the Information Age what mechanization was to the Industrial Revolution". He emphasizes the importance of computer technology for the Information Society. According to the Japanese futurologist Yoneji Masuda (1990, 4), "In the Information Society, 'an information revolution' resulting from the development of computer technology will rapidly expand the productive power of information and make possible the mass production of cognitive, systematized information, technology and knowledge". He asserts that computer technologies will be an important factor in the acceleration of social change. Masuda (1990, 32-33) also emphasizes that "An information network is seen in the transmission of information between a large number of people within an extensive area made possible by the telephone and telegraph networks. This network combined with a computer has been developed into a network system that closely resembles information mechanisms as a living body, an organism." He defines the backbone of the information network as being established by computer networks and believes it will grow with the addition of each computer. Consequently, in the Information Society, computers, in carrying out many functions, increasing the output of

information and technology as well as facilitating communication between people, have become the engines powering the growth of communication networks.

The concept of the Information Society that is associated with modernization theories appeared immediately after World War II. This concept, particularly and increasingly voiced during ongoing debates in the 1960s, is used to define a new social structure that claims to be different from the Industrial Society. In conceptualizing the Information Society, the idea that the Industrial Revolution transformed the Industrial Society was concluded. Similarly, the Technological Revolution that is focused on information technologies has transformed the Information Society. With this transition, it is understood that society, economy, politics and organizational culture have changed: computers are a major part of life; communication and circulated information have increased; and the opportunity to access information is now possible for people all over the world.

The main feature of the Information Society era is the transformation of society from a system based on the production of material goods to a system that is centered on information. Besides the main source of production being information, society and culture also depend on these new technologies and information. As economist Peter F. Drucker (1993, 7) states, "The basic economic resource of Post-Capitalist Society– 'the means of production', to use the economist's term–is no longer capital nor natural resources (the economist's 'land'), nor 'labor'. It is and will be knowledge..." Masuda (1990) considers that while the main dynamic of the Industrial Society is the production of material values, the main dynamic of the Information Society is the production of information values. He asserts that the Information Society is a new type of human society completely different from the Industrial Society. Daniel Bell (1973, 467) also concludes that "The post-industrial society is an information society, as an industrial society is a goods-producing society" (as quoted in Kumar 2005, 35). According to Bell (1980, 531), "Knowledge and information are becoming the strategic resource and transforming agent of the Post-Industrial Society . . . Just as the combination of energy, resources and machine technology were the transforming agencies of the Industrial Society" (as quoted in Kumar, 2005, 36). Statements used by scientists when explaining the concept of the Information Society describe information as being a basic economic source and state that the information sector has become the dominant "creator of added value". Consequently, with information becoming an economic asset, as a commodity it has become a 'thing' exactly as