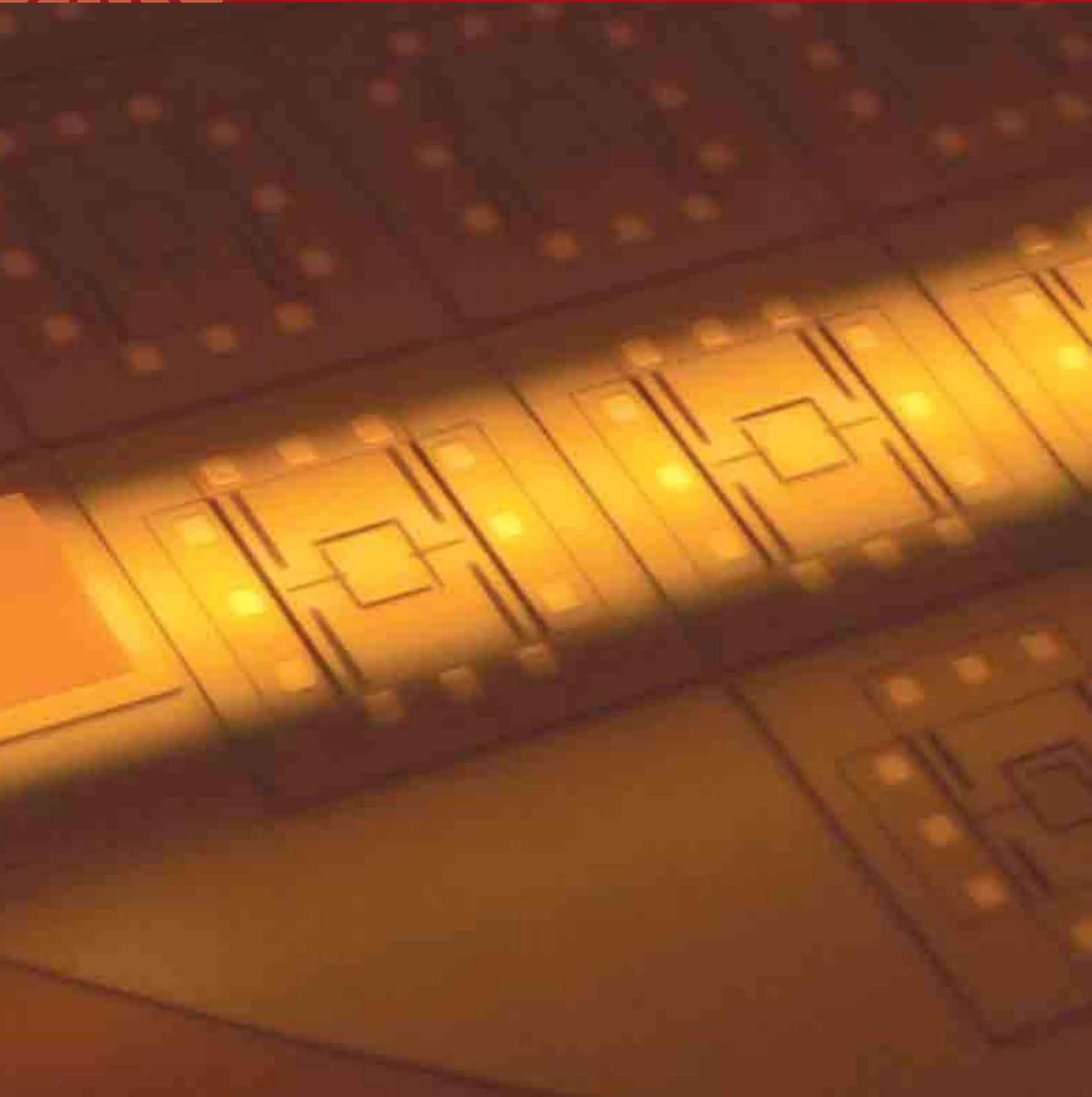
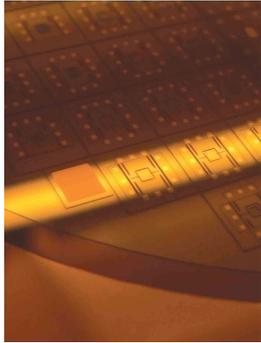


Third Issue / June 2008

# KU Frontier

Koç University's Research Magazine





## Cover Story

Cover Art shows the picture of a silicon wafer with various micro-electro-mechanical system (MEMS) devices that are fabricated in clean room environment by Koç University's Optical Microsystems Laboratory researchers. Among the devices are MEMS scanners that are used as rotating mirrors for projection displays, MEMS dynamic grating structures that are used as compact spectrometers, and MEMS dynamic stages that are integrated with microlens arrays for high-resolution imaging.



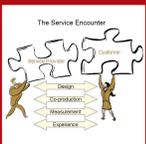
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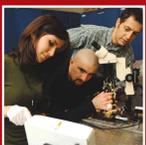
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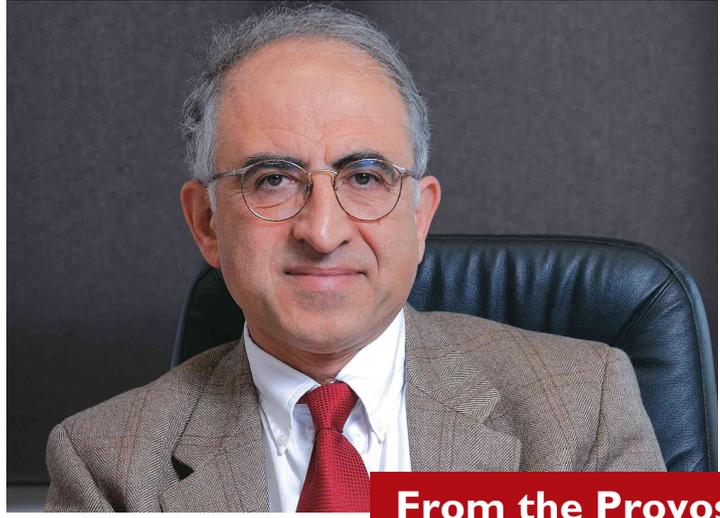
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## From the Provost

Koç University's research mission is to advance the frontiers of universal knowledge and influence the intellectual, technological, economical and social developments in Turkey and humanity at large. During the past year, research at Koç University has flourished in all fronts towards the fulfillment of this mission. In this third issue of Frontier we share with you some of these most exciting research developments.

Among Turkish universities that have degree programs comparable to ours, Koç University continued to rank in top three in terms of average publication per faculty member in the journals tracked by the Citation Indexes. In research sponsorship, we had the highest success rate in research projects funded by TÜBİTAK (The Scientific and Technological Research Council of Turkey). Our total external funding increased by 33% and reached the level of 12 million YTL. Koç University became the first Turkish university to be awarded the international IBM Shared University Research Award to establish a research center on Supply Chains.

It has been a KU tradition for our distinguished faculty to receive the most prestigious national and international awards. As you will read through the list of annual faculty awards and honors, this year is no exception. Finally with 16 masters and 10 PhD programs the number of graduate students has reached 400.

In this third issue of Frontier you will find nine articles. They address a wide range of topics covering economics, optical physics, 3D TV, optical microsystems, early childhood development, Mawlana Jalal al-Din Rumi, Turkish politics, services research at KU and Koç-IBM Supply Chain Research Center. These contributions are chosen to demonstrate some of the interdisciplinary scientific and societal value-added research that is underway at Koç University.

KU Frontier reports some important research news as well. For example we launched the European Union Project Office which will oversee the research projects funded by European Commission. We also started a Postdoctoral Fellowship Program to support the scholarly development of all qualified candidates who are committed to academic careers. Finally in the summer of 2008 we are starting a new program called Koç University Summer Research Program for Undergraduates with 49 students joining us from Turkish and foreign universities. It is the "undergraduate" version of KU Summer Research Experience for High School Students which has been successfully running since 2004. Inside the issue you will find the details on all these new programs.

I hope that you will enjoy reading KU Frontier and continue sending us your comments.

Yaman Arkun  
Provost

# Economic Research Forum's Activities in 2007 and Beyond

Established in 2004 as a non-profit and non-partisan organization, Economic Research Forum is devoted to promoting independent and objective analysis on economic growth and discussing the implications of different economic policy options.

Kamil Yılmaz > Economics

**E**conomic Research Forum (ERF) is co-founded by TÜSİAD and Koç University in 2004 and is devoted to promoting research focused on developing economic policies for sustainable development. ERF aims at contributing economic policy-making in Turkey through sponsored research projects, seminars, conferences and workshops. In these meetings, ERF invites Turkish and foreign experts as speakers, and brings together scholars from public sector, business and academia.



and the Turkish Case” which is an important contribution to the potential output gap estimation studies in Turkey.

The authors attempted to estimate the output gap using alternative models, and aimed specifically to display the correlation between NAIRU and

output gap in their comparative analysis. Crucially, deriving similar results in specific phases in all of the alternative models used to test the correlation, and especially finding potential output positive in the post-2004 period, analytically verified the homogeneity of the approach.

In this article, I intend to provide a summary of ERF's activities in 2007. The first ERF conference in 2007 was entitled “Which Potential Output Gap Measure?: The Case of Turkey”. The conference focused on the measurement of output gap, which is crucial in understanding the short- to long-term trends in Turkey.

Douglas Laxton, Deputy Division Chief at IMF Research Department, in his keynote speech, reiterated the general approach to potential output gap estimation as building a comprehensive macro model to use with Bayesian approach and evaluating the impact of various types of shocks on economy in the context of this model.

At the conference, Yasemin Türker Kaya and Zafer Ali Yavan presented their report on “Potential Output Gap Estimation Methods with an Emphasis on the Production Function Approach and the Structural Unemployment Element: A Literature Survey

After the July 22 general elections, it was commonly observed that the new government was quite slow and unwilling, by and large, when it comes to economic policies. In this context, as ERF, we wanted to stress the delay in structural microeconomic reforms, and the potential social and economic costs on Turkish economy. Hence, to create a discussion on the necessary structural reforms for sustainable growth and these reforms' medium-to-long term implications, we organized a conference on October 4 in İstanbul, entitled “Macroeconomic and Real Sector Policies in the Light of Recent Developments in Global Markets”. We asked the speakers to deal with the important policy issues in their respective fields, and they responded as follows.



Cevdet Akçay, Chief Economist of Yapı Kredi Investment and Faculty Member at Koç University, underlined the importance

of the quality of institutions and political stability for the macroeconomic policies. He further claimed that taxes and surcharges on financial transactions should be reduced and the abrogation of minimum wage should be discussed in earnest. Serhat Gürleyen, Research Director of İş Yatırım, argued that the structural problems and the delay in structural reform were complicating the transition to an export-oriented growth model.

He also emphasized that the pre-election divergence from the financial discipline was temporary and economic growth was expected to continue its pace with the decrease in public sector borrowing requirement and the increase in private sector investments. On the other hand, Professor Seyfettin Gürsel of Bahçeşehir University asserted that it is not possible to re-obtain a 6 % growth rate, in the absence of structural reforms, and added that he is not expecting another exchange rate shock.

The second session of the conference focused on the real side of the Turkish economy. Professor Hasan Ersel, Advisory Board Member of EPRI, in his speech questioned the economic program of the new government and pointed out that the initial conditions for reforms exist, hence predicting which reforms will follow gets blurred, when taking into account that reforms politically yield in the long-term. Prof. Erol Taymaz from METU marked that the domination of low-to-medium technology sectors in industrial structure should be superseded by the domination of high technology sectors. Furthermore, Taymaz stressed that the share of export in the overall foreign trade remains unchanged since 2001. In concluding his remarks, Taymaz underlined employment as one of the most important economic policy issues in Turkey and urged the government to focus on well-defined priorities on industry, technology and labor. İzak Atiyas from Sabancı University stressed liberalization as the most important pillar of reform in networking sectors. In his presentation, he discussed the importance of government supervision of the reforms played out by the regulatory agencies, in terms of the sustainability of reforms. According to Atiyas, the analytical capacity of the Competition Authority of Turkey should be increased, taking its counterparts in the US and EU as examples.

Following the October 4 conference on Turkish economy, on November 2 we organized a conference that would specifically focus on the US sub-prime crisis and its potential economic impact on the rest of the world. The title of the conference, “Decoupling of the US and World Economy,” was specifically chosen to reflect the widely debated issue of whether the emerging economies, such as China, India and others, would be able to continue with their robust growth performance while US and other industrial economies go through a recession.

Mr. Köse based his speech on a research conducted at the IMF and summarized the debate on decoupling issue without taking

a position himself. Using a commonly referred metaphor, Mr. Köse asked the question as what would happen to the rest of world if the US sneezes and contemplated on how would the response to this question differ nowadays from the past responses. According to his main hypothesis, the US remains the largest economy with largest financial markets by far, but the regional factors are becoming more important and the US spillover effects can be moderated by policy responses. Moving beyond this commonly accepted central role played by the US, he also observed that while the US’ trade links with the rest of the world weakened over time, its links through financial flows have intensified. He concluded his analysis by saying that global prospects appear half full and half empty as downside risks that could emerge from a potential persistent large financial disturbance in the US and effect global activity through financial and trade channels still dominate.



**Ayhan Köse, Ercan Kumcu**

Ercan Kumcu of Bilgi University approached the decoupling issue from a Turkey-oriented perspective and claimed that the wishful thinking by its promoters has been the driving force behind the decoupling thesis. Kumcu questioned the validity of the decoupling idea. To the contrary, he thinks that the interaction between the US economy and the rest of the world has intensified over time. The crucial question is how open are the channels through which the economies effect each other.

The panel discussion of the same conference particularly focused on global economic developments and its repercussions on Turkey. Bear Stearns Senior Analyst Tim Ash posed an EMEA ‘market’ perspective in his presentation. He asserted that EMEA has proven less volatile with marked improvements in fundamentals and has become more dependent on EU than the US. According to him, whilst the EMEA countries have moderated their exposure to the US economy, it is too early to call it a decoupling.

Hakan Kara from Turkish Central Bank based his talk on the latest inflation report by the Central Bank and stressed the

importance of dialog in monetary policy and claimed that it is the question of “which policies should be implemented to reach the target inflation?” that should be focused on. Lastly, Global Source Turkey Economist and faculty member of Koç University Murat Üçer asserted that as an economy based on domestic demand, Turkey’s ties with global economy rest on finance rather than trade, and today low growth is conceived as a crisis in Turkey whereas an FX crisis is no more likely.

The last conference of 2007 was on “Turkey’s Quest for an Industrial Strategy in Light of the International Experiences”. The keynote speech of the conference was delivered by Dani Rodrik, prominent economist and Professor of International Political Economy at the John F. Kennedy School of Government, Harvard University. In his speech, Professor Rodrik focused on the need for and the implementation of industrial policies in general, and in the Turkish context, in particular. He started his speech with the observation that the countries that had rapid growth over the last 20 years are the countries that also implemented industrial policy successfully and those countries where the market forces are left to function by themselves were unable to achieve rapid growth. He further emphasized that the success in industrial policy implementation lies in conducting a thorough analysis of the economy at the outset to diagnose the problems and to determine the policy priorities.



**Professor Dani Rodrik**

When one takes the Turkish GNP per capita to be equal to 100, the productivity of economically active population reaches its highest level with 500 in the industry, and to 100 in agriculture, and 400 in services. The huge productivity gap between industry/service sectors and agricultural sector reveals that to

improve the average labor productivity in Turkey, economically active labor force should be transferred to the industry and service related sectors. This is only possible with structural change.

According to Professor Rodrik’s estimations, if the additional labor force that emerged between 2001-2005 and amounted to 5 million people could have been employed in industry, Turkey would see an almost 20 % increase in GNP per capita even without an increase in the production capacity and employment and with no recourse to research and development, or innovation. This simple example shows how crucial a role the structural transformation can play in Turkey’s sustainable growth.

Secondly, Professor Rodrik discussed why a country like Turkey may need to have government support and subsidy policies for the industry. According to mainstream neo-liberal economic approach, there is no need for an industrial policy; to obtain a rapid industrialization, the market needs to be liberalized and the institutions facilitating market forces are promoted. According to this view, subsidy is a state intervention and leads to market distortion. Therefore, it is unnecessary. Rodrik’s opposition to this neo-liberal approach stems not only from theoretical concerns, but also from the empirical evidence observed in developing countries over the last 20 years.

The correlation between the performances of market facilitating institutions and industrial sector proves low. The huge gap between Turkey and other OECD countries may lead to question how Turkey can have a well-performing industry with the given ill-performing institutions. However, the two countries challenging Turkey in international competitiveness, China and India, are not in a better position in terms of institutional quality.

Another point stressed by Rodrik is the failure of neo-liberal policies in Latin American countries in contrast to the successes of the East/Southeast Asian countries and China which more or less implemented versions of industrial policies. Latin American countries which successfully increased labor productivity in the pre-1980 import substitution period, failed to boost labor productivity under the neo-liberal policies of the 1990s, despite overcoming macroeconomic instability and getting on the growth path again.

Industrial policy implemented by the East Asian Tigers included credit subsidies, tax reductions and intensive export subsidy programs. With these policies, they were able achieve very high growth rates from the 1960s onwards. The South East

Asian countries achieved high growth after the 1970s with their industrial policies that relied mainly on subsidizing FDI, and tax free zones. China implemented various subsidies in investment and exports, and at the same time forced the foreign investors to utilize more and more domestic inputs and transfer technology and know-how to domestic firms.

Professor Rodrik brought these country cases to the attention of the audience not to imply the simulation of these policies in Turkey, but rather to display the critical role industrial policy played in these countries' successes. The question debated worldwide and in Turkey is not whether one should have an industrial policy, but rather how should that policy be designed to get the most out of it.

According to Rodrik, industrial policy does not only mean the determination of priorities and policy tools as argued by the traditional approach to industrial policy; it is also a dialog process between the state and the private sector in which the cooperation mechanisms are established and nurtured to function properly. It is critical, for the public sector does not inherently have the necessary information for defining priorities and policy tools; cooperation with private sector is instrumental in facilitating the information base. On the other hand, in order for the private sector to become the key facilitator of the structural change, it needs the public authorities to pay attention to its main concerns, and help remove the major bottlenecks for the proper functioning of the private enterprise.

Accordingly, an industrial policy should distinguish between viable and non-viable enterprises, besides supervising private sectors' profitability. To this end, methods to bring market discipline or similar discipline mechanisms are required. Policies like providing incentives and subsidies should be temporary, e.g. the legislation can put in an automatically expiring mechanism.

Professor Rodrik indicated that the state subsidies should be extended in exchange for investment and capacity increase. Here the crucial point is not to expect the state to make right decisions on the viable sectors all the time, but to expect it to liquidate non-viable sectors/investments in any case.

Rodrik also stressed the significance of setting the priorities of the industrial policy. It is necessary to determine the prevalent limitations and create solutions to that end. For example, in Turkey we observe that the entry-exit rates in the manufacturing industry are high, so it is not a priority. Whereas the obstacles to existing companies' expansion constitutes a very important problem to be dealt with. Hence, the priority

is to identify correctly the reasons of companies' non-expansion, and to determine whether it stems from employment regulations or inadequate profitability.

Lastly, an industrial policy should be transparent. The legitimacy of industrial policies will always remain questionable, as it requires choosing among companies, sectors and regions. Therefore, the preferences should be transparent, open to public and explicable, and not based on political criteria. According to Rodrik, there are two obstacles to an industrial policy: inadequate information and politics. Public's inadequate information is acceptable, and here public-private sector cooperation proves very important. Lastly, on politics, industrial policies should be implemented in a fashion that does not lead to rent and corruption, as much as possible.

The panel session of the conference focused especially on the industrial strategy to be followed for achieving sustainable growth. EPRI Director Professor Güven Sak stressed that their surveys figured out at a four pillar industrial strategy: the restoration of investment and business environment, to move through higher value added creating sectors, the establishment of a project based (not regional) state subsidy system, and compensating policies for the losers during the transition period. First of all, an efficient dialogue mechanism between private and public sectors should be secured for the successful implementation of an industrial strategy. Furthermore, the main obstacle to the individual firm's growth in Turkey appears to be the lack of access to finance. This is a direct result of the shadow economy. Another obstacle is our legal system, which should enable more binding credit contracts.

The second panelist Agah Uğur, Chairman of TÜSİAD Industrial Affairs Commission, indicated that the current slowdown in growth rendered necessary a more integrated and supportive industrial policy. Agah Uğur also underlined that for sustainable development, private sector should invest to sectors with high value added.

The last panelist, Professor Suut Doğruel from Marmara University based his talk on the report he prepared for TÜSİAD on industrial policy and stressed the transformation in the manufacturing industry. According to Professor Doğruel, in the post-1980 period, the manufacturing industry grew much more rapidly compared to GNP and played the role of an engine for growth. However, in the following years, the industry lost this function to a large extent.

On sectoral composition, Professor Doğruel claimed that among the sub-sectors of the Turkish manufacturing industry,

high technology group did not develop since the 1980s. On the other hand, the medium to high technology industry groups encompassing electrical machinery, and machinery and equipment, achieved a dramatic advancement. Especially during the recent crises, the so-called low technology sectors' share in value added creation increased rapidly. Among the medium-to-high technology sectors of Turkey, the leading sectors are consumer electronics, automotive and the household appliances.



**ERF activities receive high media coverage**

So far, I have tried to summarize the main messages delivered by the participants in ERF conferences throughout 2007. In conclusion, I will briefly introduce ERF's web site (<http://erf.ku.edu.tr>) and discuss several pages that carry quite useful information for the visitors.

Our web site includes all information about ERF's activities and publications. The 'data' site is accessed through our homepage and includes ready to use statistics on Turkey, derived from the Turkish Central Bank's Electronic Data Delivery System. The site presents statistics in graph and table format, and aims to facilitate various statistics users' single variable data analyses. In addition to raw data graphs, Turkish Statistical Data Page also provides graphs showing one year moving averages, year-on-year change and monthly/quarterly change ratios for each variable included in the database. The annual change ratios are also provided in a separate table. The graphs in the data pages are in PNG format, and thus are downloadable.

The second part of our data page is the ERF Research Data Page. This page currently includes a graph summarizing the results of a research project which I undertake with Francis X. Diebold of University of Pennsylvania. This study analyzes the returns (black line) and volatility (red line) spillovers among the world's 19 stock markets and shows that volatility spillovers are going through bursts during crises periods, whereas returns spillover

displays an upward trend over time. The graph is updated on a weekly basis. The behavior of the volatility spillover index reveals clearly the effects of the current US financial market crisis on stock markets worldwide.



The gradual build up of tensions in financial markets and the reach to the climax of the crisis is clearly visible since last February, when the volatility spillover index was as low as 40. This meant that approximately 40% of the forecast error of volatility in 19 markets is due to spillovers of volatility shocks across markets, whereas 60% is due to self-inflicted shocks to volatility. Since then the volatility spillover index first increased to 45-50 band in early March 2007 as the financial markets started to talk about sub-prime worries, and to 65 during the unfolding liquidity crisis in August. After several points increase in late November to early December, the index reached its highest point ever at 74 in this January, after it became apparent that the US financial system is facing the real threat of insolvency of major as well as small-to-medium sized banks. Although there had been slight improvements in the index since January, the collapse of the Bear Stearns, one of the leading investment banks in the US, and its ensuing rescue operation conducted by the Federal Reserve and J.P. Morgan in mid-March brought the spillover index back to its highest level by week ending on March 21st. We interpret the current level of the volatility spillover index as a clear sign of the real economic implications of the current financial crisis in the US and the rest of the world. The US economy is likely to suffer from a prolonged recession and the world economic growth will slow down substantially in 2008 and 2009.

i. See NBER Working Paper No: 13811 at <http://www.nber.org/papers/w13811> and ERF Working Paper, No. 07-05

ii. We examine seven developed stock markets (U.S., U.K., France, Germany, Hong Kong, Japan and Australia) and twelve emerging markets (Indonesia, South Korea, Malaysia, Philippines, Singapore, Taiwan, Thailand, Argentina, Brazil, Chile, Mexico, and Turkey).

# 3DTV over IP: The Future is 3D

Transmission of 3D video signals, a problem that is currently addressed by Koç University researchers supported by the European Commission within FP6 Network of Excellence 3DTV, is a vital and challenging component of a 3DTV system.

A. Murat Tekalp > Electrical and Electronics Engineering

**A**lthough the ultimate goal in 3D video and TV may be dynamic holography, that technology is at least 10 years away, and most systems available today create 3D viewing experience via stereoscopy, that is, by showing a scene from slightly different angles to the left and right eyes of a viewer. Some 3D stereoscopic displays may require the viewer to wear specialized glasses to direct different views to different eyes. On the other hand, auto-stereoscopic displays achieve view separation on the display and do not require viewers to wear any glasses. 3DTV systems can be designed to support fixed-view stereoscopy, represented by only two views, where all viewers see the 3D scene from the same viewing angle or free-view stereoscopy, represented by multiple views, to enable viewers to watch the 3D scene from different angles within a limited viewing range on 3D displays that support this functionality.



**Figure 2:** Stereoscopic polarized projection display system at Koç University.

The history of 3D visual motion imagery can be traced back to 1903, when the first stereoscopic 3D movie was created [1]. This could only be watched from a fixed viewing angle by one viewer at a time with a modified stereoscope. In 1922, the first full length stereoscopic movie was shown simultaneously to a large group of viewers using the anaglyphic process.

Hollywood started 3D movie production in big numbers in the 1950s. While 3D cinema does not have to deal with transport issues, the broadcast industry has to deal with efficient transport of 3D content, in addition to issues related to effective and inexpensive 3D displays for successful commercial deployment of 3DTV. Hence, transmission of 3D video signals, a problem that is currently addressed by Koç University researchers supported by the European Commission within FP6 Network of Excellence 3DTV, is a vital and challenging component of a 3DTV system.

Development of efficient 3DTV transport technology requires thorough consideration of the end-to-end system, including the 3D display technology, visual data representation and rendering, as well as capture and encoding methods. Different display technologies may mandate different visual data representations, which in turn may affect the optimal compression and transport strategies. The evolution of 3DTV transport technology follows the path of analog broadcast, digital broadcast over terrestrial and satellite, and most recently streaming and broadcast over the Internet Protocol (IP), also known as IPTV. Live broadcasting of stereoscopic HDTV was demonstrated during the Winter Games, Nagano, Japan in 1998. A similar experiment was conducted in Korea/Japan during FIFA World Cup 2002 using a terrestrial and satellite network. The reader is referred to [2, 3] for a thorough review of analog and digital (terrestrial and satellite) broadcast technologies.

The Internet Protocol (IP) is proving to be very flexible in accommodating a wide range of communication services as can be seen from the ongoing replacement of classical telephone services by voice over IP applications. Transmission of standard

2D video over the Internet is currently an active research and development area, where significant results have already been achieved. There are already video-on-demand services, both for news and entertainment applications, offered over the Internet. Also, 2.5G and 3G mobile network operators started to use IP successfully to offer wireless video services. Looking at these advances, the transport of 3DTV signals over IP packet networks seems to be a natural choice. While the transport solutions must address backwards compatibility issues with the existing digital TV standards and infrastructure, and, hence, can only support a limited set of 3D data representations and rendering technologies, the streaming over IP solutions offer more flexibility to support different 3D displays, 3D data representations, and compression options. The IP itself leaves many aspects of the transmission to be defined by other layers of the protocol stack and, thus, offers flexibility in designing the optimal communications system for various 3D data representations and encoding schemes.

**Development of efficient 3DTV transport technology requires thorough consideration of the end-to-end system, including the 3D display technology, visual data representation and rendering, as well as capture and encoding methods.**

### 3DTV Streaming and Broadcast over IP Networks

3DTV streaming architectures can be classified as: i) server unicasting to a single client, ii) server multicasting to several clients, iii) peer-to-peer (P2P) unicasting, where each peer forwards packets to another peer, and iv) P2P multicasting, where each peer forwards packets to several other peers. Multi-view video streaming protocols can be RTP/UDP/IP, which is the current state of the art, or RTP/DCCP/IP, which is the next generation protocol. Multicasting protocols can be supported at the network-layer or application layer.

For streaming applications, we encode multi-view 3D video either implicitly, in the so-called “video-plus-depth” representation, or explicitly in raw representation. The “video-plus-depth” representation has been standardized within MPEG (Motion Pictures Experts Group). Only the representation has been standardized – by means of metadata which conveys the meaning of the graylevel values in the depth imagery – and some additional metadata to signal the existence of an encoded

depth stream. The actual compression of the per-pixel depth information, on the other side, has not been defined explicitly such that every conventional MPEG video codec (e.g., MPEG-2 or H.264/AVC) can be used for this purpose. The new standard has been published in two parts: The specification of the depth format itself is called ISO/IEC 23002-3 (MPEG-C), and a method for transmitting “video-plus-depth” within a conventional MPEG-2 Transport Stream has become an amendment (Amd. 2) to ISO/IEC 13818-1 (MPEG-2 Systems). There are various approaches for representation and encoding of multi-view video, which provide a trade-off between random access, ease of rate adaptation, and compression efficiency [4]. These approaches include simulcast coding, scalable simulcast coding, view-selective coding, multi-view coding and scalable multi-view coding.

In streaming multi-view video over the Internet, the video rate must be adapted to the available throughput and/or the TFRC rate in order to avoid congestion to be friendly with other TCP traffic. The rate adaptation of stereo and multi-view video differs from that of monocular video, since rate allocation between views offers new flexibilities. According to the suppression theory of human visual perception of 3D from stereoscopic video, if the right and left views are transmitted and displayed with unequal spatial, temporal and/or quality resolutions, the overall 3D video quality is determined by the view with the better resolution [5]. Therefore, rate adaptation of multi-view video may be achieved at constant perceived 3D video quality by adaptation of the spatial, temporal and/or SNR resolution of one of the views while encoding/transmitting the other view at full rate. Several open loop and closed loop rate adaptation strategies for stereo and multi-view video at the server and client side are studied for UDP and DCCP protocols. In the closed loop rate adaptation, each client estimates some function of the received signal and feeds it back to the transmitter. The transmitter determines an optimized rate for the next transmission based on the received feedback. In the open loop rate adaptation, the transmitter does not use any feedback from the receiver.

Streaming media applications often suffer from packet losses in the wired or wireless IP links. Congestion is the main cause of packet losses over the wired Internet. In contrast to the wired backbone, the capacity of the wireless channel is fundamentally limited by the available bandwidth of the radio spectrum and various types of noise and interference, which lead to bit errors.

Most network protocols discard packets with bit errors; thus, translating bit errors into packet losses. Therefore, the wireless channel is the “weakest link” of future multimedia networks and, hence, requires special attention, especially when mobility gives rise to fading and error bursts. In particular, joint source and channel coding techniques have been developed for efficient transmission of video streams over packet erasure channels, both in wired and wireless networks. Furthermore, error concealment methods at the decoder must be considered in order to limit the damage, especially due to temporal error propagation, resulting from unpreventable packet losses.

Since large amounts of data is involved in the transmission of real-life like 3D multimedia experiences, we are currently considering distributed delivery scenarios, where both wired and wireless peers may partially or fully cooperate between each other.

### 3D Video Streaming Demonstrations

Recently, we demonstrated an end-to-end prototype system for point-to-point streaming of stereoscopic/multi-view video over UDP at the International Broadcasting Convention (IBC) 2007 [6]. A block-diagram of the prototype system is shown in Figure 1. The server employs the protocol stack RTP/UDP/IP, and can serve multiple clients simultaneously. The server supports both raw and “video-plus-depth” representations and encoding. The session description protocol (SDP) is used to ensure interoperability with the clients [7, 8]. Multiple clients have been developed for different 3D displays: Client-1 supports the auto-stereoscopic Sharp 3D laptop, Client-2 supports a monocular display to demonstrate backwards compatibility, and finally Client-3 supports an in-

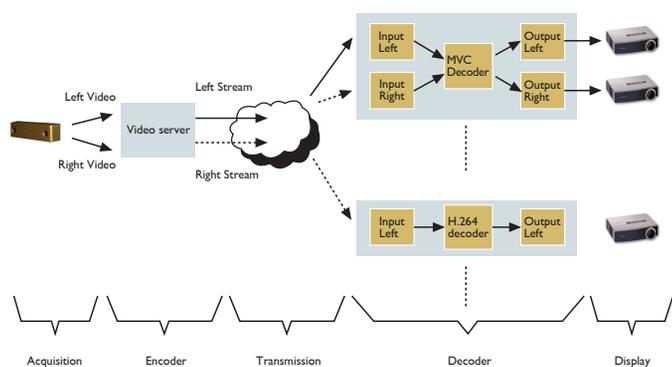


Figure 1: A block-diagram of the end-to-end stereoscopic video streaming

house polarized 3D projection display system that uses a pair of Sharp MB-70X projectors as shown in Figure 2.

### Future Direction: Cooperative Streaming and Broadcasting

Since large amounts of data is involved in the transmission of real-life like 3D multimedia experiences, we are currently considering distributed delivery scenarios, where both wired and wireless peers may partially or fully cooperate between each other. In a cooperative networking scenario, each peer may use some of its resources in order to contribute to the delivery of content to other peers. However, challenges related to availability/discovery of peers that are willing to cooperate and has the desired content, scheduling of which part of the content should be requested from which peers (i.e., content provisioning) in an efficient way, and fairness among all peers must be addressed. We are currently investigating how to optimize the type and level of cooperation between peers dynamically in time. The proposed collaborative streaming framework towards the 3D Internet of the future will be adaptive in terms of the level of cooperation, which is time-varying depending on available peers, desired type and quality of content and allowed delay in the application scenario.

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# The Study of Early Childhood Developmental Ecologies in Turkey (TECGE)

TECGE aims to provide an infrastructure to developmental scientists in Turkey and elsewhere, to gain an in-depth understanding of causal processes that link the contexts of early childhood to cognitive and socio-emotional developmental trajectories that evolve over the ages 3 to 7.

Nazlı Baydar and Nuran Aydemir > Sociology-Psychology

**T**ECGE is a large scale longitudinal study of early childhood in Turkey. This study is carried out by the following members of the departments of Psychology and Sociology of Koç University: Nazlı Baydar, Zeynep Cemalcılar, Fatoş Gökşen, Aylin Küntay and Bilge Yağmurlu.

Early childhood is a period when key cognitive, social and emotional capacities are developed. Because this developmental period precedes school ages, the capacities developed during this time strongly influence school adjustment, school attachment, and school achievement. School related outcomes tend to have continuity and may, in turn, shape long term socio-economic well being of individuals. Therefore, understanding the trajectories of early childhood development and delineating the factors that influence these developmental trajectories are important goals for developmental science. Such an understanding is also a key to the formulation of sound social and educational policies.

Early childhood development takes place in social institutions that are largely unstructured by educational policy. These institutions could be the nuclear and the extended family, the neighborhood, non-family care providers, and the nursery school or the preschool. According to widely held current developmental theories, these contexts of early childhood and a child's developmental trajectory will mutually influence each other [1]. The developmental trajectories of children are shaped through this dialectic process. Thus, it is essential that the dynamic processes linking the social contexts of development (i.e., the developmental ecologies) and children's cognitive, social and emotional development are studied and understood. In Turkey, where preschools are not widely available and structured

institutional education may not be deemed necessary or culturally desirable in early childhood, understanding informal developmental contexts of early childhood development gains further importance.

The Study of Early Childhood Developmental Ecologies in Turkey (TECGE) is designed as a longitudinal study that focuses on the specification and measurement of developmental ecologies and their influences on the development of children in Turkey throughout early childhood years. The remainder of this article describes the goals and significance of TECGE, difficulties that must be overcome to implement this study, and some information from the pilot study of TECGE that was completed a few months ago.

## Goals and Significance of TECGE

TECGE aims to study developmental ecologies of children in Turkey. Developmental ecologies that are considered in TECGE are the nuclear family, the extended family, the school and the community contexts of the child. TECGE further considers the interactions of these contexts with each other as a relevant aspect of early childhood context. Thus, all social-environmental factors that could potentially influence the cognitive and socio-emotional development of children during early childhood are in the scope of TECGE. Achieving a detailed qualitative and quantitative understanding of the process of interaction between different developmental ecologies; and, between each developmental ecology and developmental outcomes is the goal of TECGE. In doing so, TECGE will support the formulation of effective educational policies and interventions that aim changes in the existing informal structures or aim to create new contexts in

order to support optimal cognitive, social and emotional development of children. Examples of early childhood developmental programs in Turkey are those initiated by Mother Child Education Foundation (Anne Çocuk Eğitimi Vakfı-ACEV) such as “7 Is Too Late” or “Mother Child Education Program.” By focusing on the context of early childhood development, TECGE follows the tradition of longitudinal studies of early childhood conducted in the United States and Europe, such as the Children of the National Longitudinal Survey of Youth [2], Early Childhood Longitudinal Study [3-6], National Child Development Study [7-12], and the Millennium Cohort Study [13-17]. However, the contexts of early childhood and the interactions of individuals in these contexts are strongly influenced by cultural norms. Therefore, it is unlikely that the findings of these previous studies can be generalized to understand the developmental trajectories of children in Turkey where a collectivistic culture prevails. The nature of the early childhood ecologies, their meanings for parents and children, and the way they influence cognitive, social and emotional development are expected to be qualitatively different from comparable processes in Western individualistic societies.

Developing societies often have limited resources to support human development and education. When resources are limited, it is all the more important that resources are effectively used to support the optimal development of human capital. TECGE will address this need in Turkey, where funds for social and educational programs are limited but the need for supporting optimal human development is great. In comparison to European and North American societies, Turkey has a very young population. Although fertility has declined, it is higher than developed societies. Somewhat high fertility combined with a large young population of childbearing ages contributes to a very large population of children. In 2008, Turkey has the world's 17th largest child population with over 6.5 million 0-5 year old children [18]. Supporting the optimal development of these children may constitute the most influential socio-economic policy for the future welfare of the Turkish society. TECGE will help understand the ways in which optimal development may be supported in the Turkish society, where early childhood is influenced by institutions that are informal and strongly shaped by the collectivistic culture.

TECGE has certain attributes that distinguish it from its predecessors in Turkey and other developing collectivistic societies. First and foremost, TECGE has a longitudinal design, i.e., it will follow the development of a sample of children over time. This is the most appropriate way to detect developmental changes and their determinants. Development, by definition is a dynamic process, and must be studied in a way to capture that dynamics. Another unique feature of TECGE is that it is designed

to be a study with a sample that is representative of the children in Turkey. Whereas previous studies in Turkey mostly collected information from large metropolitan areas, TECGE will have full national geographical coverage because it will apply scientific methods of sampling using a stratified geographical sampling technique. TECGE is expected to accomplish the following:

- To collect data from a scientifically designed nationally representative sample of families in order to ensure external validity of the findings;
- To identify the developmental trajectories and the variability in these trajectories by following large national sample longitudinally for five years;
- To conceptualize early childhood development in its social and cultural context and to measure family and community level developmental ecologies accordingly;
- To conduct quantitative and qualitative measurements of cognitive, social and emotional developmental levels of children using a set of measures that can be standardized for comparative and cross-cultural studies; and,
- To share all data, assessments, and documents of TECGE with all interested researchers through the Internet, thereby contributing to the establishment of an infrastructure for furthering the advancement of developmental science in Turkey.

### **Difficulties in the Implementation of TECGE**

Inevitably, there are some difficulties associated with conducting a research program such as TECGE in Turkey, because of Turkey's meager past in applied developmental research. Two such difficulties are discussed here: the lack of Turkish language assessment instruments that can be used in a large scale study, and the lack of adequate theoretical and empirical knowledge about child development in Turkey or other comparable collectivistic societies.

Empirical quantitative developmental research requires the use of valid and reliable assessments that have been developed and psychometrically established in the target population. Unfortunately, there exist few developmental assessment instruments that fulfilled these criteria for the population of Turkish children for measuring their cognitive, social and emotional developmental level. Few Turkish language assessments that were available had been established for Turkish children coming from families who were relatively well educated and economically well off but none had demonstrated validity and reliability in Turkish families of low socioeconomic status. Additionally, most of the instruments were originally developed for use in Western individualistic societies and translated to Turkish language but not adapted to the Turkish collectivistic family. For example, what parents consider as indicators of their children's behavior problems will vary strongly depending on the cultural context.

Instruments that could measure specific aspects of children's developmental ecologies were also very sparse. Furthermore, cultural bias in measurement could be even more severe in the measurement of developmental ecologies than the measurement of children's developmental level. TECGE aims to measure all relevant developmental ecologies, the meaning of various aspects of those ecologies, and how different ecologies interact with each other. All of these attributes are strongly dependent on the cultural context. In order to capture these nuances, the instruments must be as culturally sensitive as possible, while not compromising cross-cultural comparability and psychometric standards.

TECGE research team consisting of developmental and social psychologists, family researchers, demographers and sociologists spent approximately a year to develop a battery of assessments that measure child developmental level and specific aspects of developmental ecologies and their interactions. Many measures were either created or adapted from English originals to get acceptable validity and reliability. TECGE is now in a position to contribute to developmental science in Turkey by making available culturally sensitive and psychometrically sound measures for the assessment of developmental level and developmental ecologies.

In addition to the problems related to the lack of psychometrically sound measurement instruments, TECGE faced problems related to the lack of theoretical developmental research that has been validated across a variety of cultural contexts. Such theoretical research is sorely needed in order to guide empirical research activities by delineating what to measure, in addition to how to measure, and suggesting what aspects of developmental ecologies co-occur and what aspects operate independently. A case in point is the conceptualization of controlling parenting.

One of the key ecologies of early childhood is the mother-child relationship or parenting behaviors. In individualistic societies, controlling parenting is strongly associated with a high level of negative parenting behaviors (i.e., harsh parenting and rejection of the child by the parent) and a low level of positive parenting behaviors (i.e., lack of supportive or warm behaviors). It has been demonstrated that controlling parenting is associated with a range of socio-emotional problems in children in individualistic societies.

In collectivistic societies, parental control often exists in a context of parental warmth and support, and does not imply a harsh disciplinary approach. In that way, its effects on children are often not negative. Thus, conceptually, controlling parenting is distinct from harsh parenting and parental rejection, and must be quantified as a distinct parenting dimension. Indeed it may have even further detailed components such as psychological vs. behavioral control of children by their parents. These distinct

aspects of parenting behaviors must be assessed separately and analyzed separately to empirically demonstrate how they individually and interactively influence children's developmental trajectories.

This example underscores the importance of conceptual cross-cultural work in developmental psychology that will contribute to the understanding of aspects of early childhood ecologies that influence children's development. TECGE will help support such cross-cultural conceptual research that is empirically grounded. TECGE will help delineate the aspects of early childhood ecologies that must be measured and the causal processes that link them to children's developmental trajectories.

### **Pilot Study of TECGE and Some Findings**

Because of the ambitious and groundbreaking goals of TECGE, an extensive pilot study was planned prior to embarking on a national data collection effort. The purpose of the pilot study was twofold. First, the research team needed to evaluate the feasibility of collecting data from families of young children with a 2.5 hour (average) protocol that involved assessments of the children and the mothers, as well as a relatively long interview with many questions pertaining to family and community life. The acceptability of the study protocols by the families and the potential difficulties in the field needed to be evaluated. Second, the psychometric attributes of the study instruments needed to be assessed and the instruments needed to be revised accordingly.

The pilot study of the TECGE was completed with 51 mothers and their children between 36-47 months of age in August, 2007. These families were recruited from five different neighborhoods of Istanbul that were known to be communities of very low or low socio-economic status. Istanbul was chosen for the pilot study since Istanbul receives a lot of migrants from other regions of Turkey. Therefore, individuals from diverse ethnic, cultural, and regional origins could be interviewed in Istanbul. The pilot sample consisted of a very high proportion of mothers who had limited education. Indeed, 78% of the mothers and 60% of the fathers had only completed five years of primary education. Thus, the pilot study served to demonstrate whether the TECGE protocol could be completed and interview items could be understood and responded to by mothers who had very little education.

The sample of the pilot study consisted of young mothers averaging 30.5 years and ranging between 23 and 37 years old. A majority (57%) of the mothers were born in rural locations or small towns. More than a third of the sample (39%) had lived in rural locations or small towns most of their lives. The mothers had been married for almost 10 years, on average, ranging between 4 and 25 years. They had an average of 2.4 children, ranging between 1 and 6 children.

The scales, questionnaires and developmental tests which were used in TECGE pilot study are listed in Table 1. During the pilot study video and voice recordings were also collected in order to support quantitative data collection with qualitative data. Each mother-child pair was asked to continue their regular daily activities for 10 minutes of unstructured observation and they were given a joint play task for another 10 minutes of semi-structured observation. Both of these observational protocols were video recorded. In addition, each mother and each child, separately, were asked to narrate a story using a picture book that was provided to them. These narratives were voice recorded for subsequent transcription and coding.

The quantitative data from the pilot study helped finalize measurement instruments for the main field study of TECGE. The resulting set of assessments for children's developmental outcomes and their early childhood ecologies have good reliability and validity. The pilot study also revealed some interesting preliminary results that indicated what may be learned from a major developmental research program such as TECGE.

One of the preliminary findings pertained to the socio-emotional development of the 3 year-old sample who participated in the pilot study. It was found that obedience demanding behavior of the mother and a high level of harsh punishment was associated with a high level of behavior problems in these 3-year old children. This finding replicates what is already known in developmental research. In addition, a high level of hostility directed towards the mother by the father was associated with a high level of behavior problems in children. In other words, the relationship between the mother and the father (i.e., an aspect of the family ecology that the child was not in direct contact with), had a direct influence on the child's behavior problems regardless of the mother's parenting behaviors. TECGE pilot findings also indicated that the mothers who reported having close and supportive friends (other than the extended family members) had significantly less obedience demanding behavior and used significantly lower levels of harsh punishment. Thus, the mother's social ecology outside of the family measurably influenced her parenting behaviors which, in turn, influenced the child's behavioral development. In Turkey, where a vast majority of mothers of young children do not work and are confined to the social support provided by the family members, this finding suggests the importance of a social support network that is independent of the extended family. These findings are tentative due to the small and limited scope of the pilot study. Nevertheless, they illustrate the wealth of knowledge that can be gained when a broad array of developmental ecologies are assessed concurrently with children's developmental indicators.

Another finding from the TECGE pilot study pertained to the narrative samples taken from the mothers and their children. The

preliminary analyses of the narratives indicated that the mothers' narrative abilities varied extensively although all mothers had relatively low levels of education. This finding implies that maternal narrative capacity, which is one of the major determinants of the development of verbal abilities in children, cannot be predicted by the level of education of the mother. This may be especially true among those segments of the population where access to education by females is limited by their families regardless of their cognitive capacity. This finding was also supported by the quantitative data from the TECGE pilot. Academic stimulation (i.e., teaching numbers, words, colors, shapes to children) and language stimulation (i.e., making an effort to speak in complete and complex sentences, supporting the child's speech) are known to be two important aspects of a child's developmental ecology that predict cognitive development. In the TECGE pilot sample where mothers had low levels of education, the level of academic and language stimulation provided by the mothers was associated with mothers' cognitive abilities (as indicated by their working memory) and their vocabulary knowledge, but not by their level of education. Maternal education is known to be a very good indicator of children's developmental ecologies in developed societies where (unlike in Turkey) females and males have equal and easy access to basic education. The TECGE pilot study, however, suggests that maternal education may not be a good indicator of children's developmental ecologies in Turkey.

## Conclusion

TECGE is designed as a national longitudinal study of early childhood in Turkey. As such, it aims to provide an infrastructure to developmental scientists in Turkey and elsewhere, to gain an in-depth understanding of causal processes that link the contexts of early childhood to cognitive and socio-emotional developmental trajectories that evolve over the ages 3 to 7. TECGE is designed to address early childhood development from a cross-cultural perspective. By keeping the cross-cultural perspective prominent in the design and implementation of the study, TECGE will help validate developmental theories that have been tested largely in a limited number of individualistic societies. To accomplish this goal, TECGE measures the developmental ecologies of children that may be significant in a collectivistic and developing society (such as the extended family or the residential community) although these ecologies may be insignificant in their influence on the nuclear family in individualistic societies. The pilot study of TECGE and the preliminary findings of the pilot study already show promise that our understanding of early childhood developmental processes may be greatly advanced by a cross-cultural approach integrating qualitative and quantitative developmental research.

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**Table 1. Scales, questionnaires, forms and developmental tests of the TECGE Pilot.**

Name of the questionnaire/scale	Information about the source of the scale	Whether the scale was modified for TECGE or not
1. Demographic Information Form	Developed by TECGE Team.	√
2. SF-36 Quality of Life Scale	MOS-36 Health Survey <sup>19</sup>	√
3. Brief Symptom Inventory	Developed by L. R. Derogatis (1992) <sup>20</sup> . Turkish version was developed by Şahin, N. H. & Durak, A. (1995) <sup>21</sup> .	X
4. The Index of Perceived Social Support	Developed by: Henderson et al., 1978 <sup>22</sup> . Turkish version was developed by Kumru, Sayıl & Yağmurlu <sup>23</sup> for a TÜBİTAK project.	√
5. Multidimensional Scale of Perceived Social Support	Developed by Zimet, Dahlem, Zimet & Farley, 1988 <sup>24</sup> .	√
6. Neighborhood Ecologies Questionnaire	Developed by TECGE Team.	
7. Marital Satisfaction Questionnaire	Developed by Baydar, N. & Yumbul, C. 2005 <sup>25</sup> , Unpublished Study.	√
8. Semi-Structured observational Protocol	Developed by TECGE Team.	
9. Child/Mother Physical Health Questionnaire	Developed by TECGE Team with General Health Perception subscale of SF-36.	√
10. Parent Goals Questionnaire	Developed by Schaefer and Edgerton, 1985 <sup>26</sup> . Turkish version was developed by Yağmurlu & Sanson, 2004.	√
11. The Short Temperament Scale for Children	Developed by Prior, MR., Sanson, AV & Oberklaid, F. 1989 <sup>27</sup> . Turkish version was developed by Kumru, A., & Yağmurlu, B. TÜBİTAK project <sup>27</sup> .	√
12. The Adaptive Social Behavior Inventory (ASBI)	Developed by Hogan, Scott, & Bauer, 1992 <sup>28</sup> . Turkish version was developed by TECGE Team.	√
13. The Eyberg Child Behavior Inventory (ECBI)	Developed by Eyberg, S., & Pincus, D. (1999) <sup>29</sup> . Turkish version was developed by Kumru, Sayıl & Yağmurlu (2006) <sup>23</sup> .	√
14. Child Rearing Questionnaire	Developed by Sanson (1994) <sup>30</sup> . Modified by Paterson & Sanson (1999) <sup>31</sup> . Turkish version was developed by Boratav (2003) <sup>32</sup> .	√
15. Child Care	Developed by TECGE Team.	
16. Mullen Scales of Early Development	Developed by Mullen, 1992 <sup>33</sup> . Turkish version was developed by Küntay, 2007 (Mullen Early Learning Scales).	X
17. Frog Story protocol	Applied by Berman & Slobin, 1994 <sup>34</sup> ; Strömqvist & Verhoeven, 2004 <sup>35</sup> . Turkish version was developed by TECGE Team.	X
18. Working Memory Protocol	Developed by Gülgöz, 2004 <sup>36</sup> .	X
19. ACEP Word Knowledge Test	Developed by Gülgöz, 2004 <sup>36</sup> .	X
20. HOME	Developed by Caldwell & Bradley, 1984 <sup>37</sup> . Turkish version was developed by TECGE Team.	√
21. Interviewer Impression Scale	Developed by TECGE Team.	

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# Services Research at Koç University: Cutting Across Disciplines

Creation and delivery of high value services requires a multidisciplinary approach combining design, engineering, operations, marketing, and human resource management.

Zeynep Akşin Karaesmen > Business Administration

**M**ost economic activity in the world takes place in services, reflected in a high share of these in GDP and employment statistics of most developed and developing nations. In addition to growing service sector firms, a large part of the growth in service activity is coming from sectors that are traditionally not classified as services. In a trend known as “servitization”, manufacturing firms are bundling services along with their products and generating a significant portion of their revenues from these services, in the process shifting from a transaction focus to one that entails relationships. Increased competition and new information technologies have stimulated the growth of customized and personalized services, allowing these to be sourced globally. Today, complex service supply chains operate globally in an environment where higher levels of customer satisfaction are sought.

All of these trends naturally imply a diverse set of businesses, processes, and systems all labeled as services. Within this diversity, a particular characteristic of services provides a common platform for their study: a significant portion of services are designed, produced, distributed and consumed by their, or in the presence of, their customers. This requires a focus on service encounters, or in other words a focus on all customer contact points with a service organization, thus ensuring profitability and growth, both closely tied to customer service experiences, customer satisfaction and loyalty. In settings with high customer contact, quality control implies process control. Furthermore in addition to its operational features, the process is affected by both human resource management and the management of the co-producing customer. This brief glimpse at the role of customer contact suggests the need for a multi-disciplinary study of services. Design, engineering, operations, marketing, and human resource management all play a role in creating and delivering high value services.

Services research at Koç University reflects this multi-disciplinary characteristic of services, taking a system perspective that cuts across the boundaries of different departments and schools. Rather than reviewing all of the research on services at the university, this article will focus on service encounters as a unifying theme and

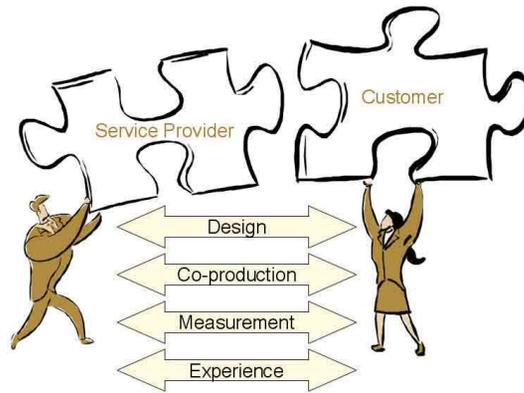
provide examples of research coming from different disciplines under three different topics: repeated service encounters and their ties to growth and profitability are studied under customer relationship management, people in service encounters are the focus of human aspects of services, and encounters between service businesses are grouped under service sourcing and service supply chains.

## Customer Relationship Management

The study of customer relationship management is a prolific area of research in the Marketing Group at Koç University. A recent edited volume by Aksoy, Keiningham, and Bejou (2007) provides a diverse set of studies illustrating how to “collect, compile and make best use of customer information to better manage customer value and firm profitability”. Cross-selling, the marketing of additional products to customers at service encounters, constitutes one example of a growth seeking customer relationship tactic. Rather than growing through an increase in market share, companies that adopt this practice seek to grow by increasing the share of wallet (i.e. share of purchases in the category). While managers agree that one cannot sell to a dissatisfied customer, empirical evidence linking customer satisfaction and share of wallet has been limited. The paper by Cooil, Keiningham, Aksoy, and Hsu (2007) is important in this regard and addresses this gap in the literature by making use of a longitudinal data set. This result suggests that successful cross-selling requires customer satisfaction.

In a call center context, customer satisfaction is closely tied to the waiting experienced by customers, which can be controlled by determining appropriate capacity levels. Studying cross-selling in a call center from an operations management and service engineering perspective using queueing models, Akşin and Harker (1999) demonstrate that unless capacity is carefully planned, cross-selling will lead to increased congestion, thereby affecting customer satisfaction negatively and potentially leading to a downward spiral in cross-selling performance. This observation has led to subsequent research by Örmeci and Akşin (2007), which characterizes dynamic controls for the right customer and the right time to attempt a cross-sell as a function of queue state and customer revenue potential.

## The Service Encounter



Viewing failed cross-selling attempts as service failures and a source of dissatisfaction for customers, Güneş, Akşin, Örmeci, and Özden (2008) model relationship dynamics and characterize the structure of optimal cross-selling policies as a function of relationship state and previous failed attempts. The study illustrates how ignoring negative customer reactions to failed cross-sell attempts can lead to significant value loss.

This stream of research combines a service business perspective at the intersection of marketing and operations, with industrial engineering, and customer behavior perspectives, thus providing a vivid example of cross-disciplinary research.

### Human Aspects of Services

Human resource management is essential in settings where most of the value is added during service encounters. In accounting, a formal approach to value human assets has not been adopted, even though its importance is articulated by many in the field. Focusing on knowledge intense services, Akşin (2007) provides an optimization based approach that combines the problems of manpower planning and human resource valuation. The paper suggests “appreciation” or depreciation schedules for learning human assets of a service organization. Once again, an interdisciplinary approach at the intersection of human resource management, operations research and accounting is apparent.

In many encounters, certain actions and choices are at the discretion of the service employees. Güneş and Akşin (2004) present and analyze an incentive design problem for settings where the service employee needs to provide different lengths of service to different customer types. Longer service creates congestion but also helps generate additional value. The server can see a customer’s type however the manager cannot monitor this and the server may prefer a short service over a long one despite potential value to be gained from the latter. The manager resorts to incentive mechanisms to overcome this information asymmetry problem. The paper illustrates the ties between a market segmentation problem in marketing, which consists of defining different customer types, operational choices regarding the type of service to be provided to each type, and incentive schemes, thereby linking marketing, operations, and human resource management.

### Service Sourcing and Service Supply Chains

Encounters between service businesses may occur between firms or between different departments or internal structures within firms. The former type of relationship is frequently governed by contracts. Service supply chain contracts are analyzed in the context of call center outsourcing in Akşin, De Vericourt, and Karaesmen (2008). The paper demonstrates the

role operational features play on a choice between different types of contracts. An empirical analysis based on European data explores shared service centers, or internal structures established to take care of business services within organizations. The analysis challenges the notion of “best practice” and suggests that the effectiveness of a shared services project depends on the degree of

complementarity between the “needs” arising from the environment in which a company operates and the specific capabilities developed to address these needs (Akşin and Masini, 2008). An ongoing area of growth for research on service supply chains is in the pharmaceutical industry (Gür Ali, Mantrala, Çavdaroglu, 2008) and in healthcare (Güneş and Yaman, 2005).

Research on services at Koç University is expected to grow, positioning it as one of the leading knowledge centers on the topic in Europe.

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# Micro-Nano and Optical Electro-Mechanical Systems

Integration of micro-optics and micro/nano electro-mechanical systems leads to novel applications.

Hakan Ürey > Electrical and Electronics Engineering

**O**ptical Microsystems Laboratory (OML) is conducting applied research in micro and nano technologies with a focus on integrating micro/nano optical and electro-mechanical systems (MEMS and NEMS). There are more than 10 externally funded development projects including 2 recent FP7-STREP projects from EC. The main focus of our research is the development of novel enabling technologies for a number of applications including cell-phone projectors (classified as pico-projectors), thermal imaging cameras for night-vision, ultra-miniaturized spectroscopy instruments for chemical and biological analysis, disposable bio-nano sensors (fully fabricated in our own clean room), and novel 3D displays.

In this article we describe 3 of the aforementioned project areas where our MS and PhD students are among the co-inventors on a number of US and European patents and the technology is already licensed to our commercial development partners.



## FR4 scanners for display and imaging applications (patented and licensed to Microvision Inc., USA)

Laser scanners are being employed in many devices like high resolution display systems, barcode readers and biomedical imaging equipment. We have many years of experience in design and development of micro-scanners using Silicon technology. In the recent years, we adapted FR4 as a new material in our scanning systems. FR4 is a polymeric epoxy-glass resin and the most commonly used material used in printed circuit boards (PCB) used inside all the electronics equipment. Therefore, the technology is widely available at low-cost. OML is the first research group in the world to utilize FR4 as a platform to integrate electrical, mechanical, and optical functionalities [1, 2].

FR4 is a well engineered material in terms of electrical, thermal and mechanical stability due to its broad use in all types of environmental conditions. With our new area of research, we propose FR4 as a new optical microsystems platform. (Figure 1) Along with the increasing precision in PCB manufacturing technology, especially with the incorporation of laser cutting in the routing process, fine features can be achieved with less than 20 $\mu$ m precision.

Electromagnetically actuated FR4 scanners made from PCB can be seen in Figure 1a. The actuation involves passing a current through the copper coil routed on the PCB and an external magnet. A 2D scan waveform produced with such a scanner can also be seen in Figure 1b. 2D scanning is made possible by use of a single drive coil, which is an important novelty in the design and described in [3].

We have already attracted the attention and support of an industrial partner, Microvision Inc., USA, a company listed in top 20 among electronics companies with respect to patent impacts according to a survey by the Spectrum Magazine of IEEE. We

are currently focused on two applications: a high performance barcode reader and a high resolution miniature projection device called pico projector incorporating a MEMS scanner (Figure 2). Serhan Isikman and Sven Holmström are the main researchers in those projects. Several others from OML also participate in test and evaluation of the prototypes.

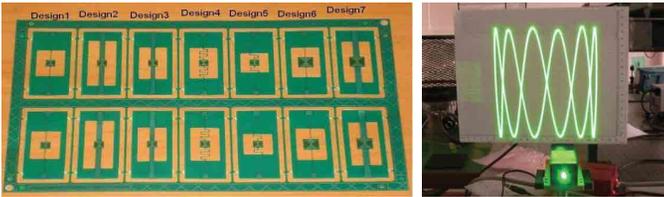


Figure 1. (a) A sheet of FR4 containing seven different scanner designs produced by conventional PCB technology, (b) 2D scan pattern produced by one of the scanners in (a).



Figure 2: Pico-projector embedded in mobile phones (courtesy of Microvision Inc.)

The main focus of our research is the development of novel enabling technologies for a number of applications including cell-phone projectors (classified as pico-projectors), thermal imaging cameras for night-vision, ultra-miniaturized spectroscopy instruments for chemical and biological analysis, disposable bio-nano sensors (fully fabricated in our own clean room), and novel 3D displays.

### Thermal-Imaging Camera for Night Vision (patented and licensed to ASELSAN-Turkey)

Based on its temperature every object emits blackbody radiation energy, which is mostly in the infrared band. Thermal cameras are designed to create image of objects by collecting this radiation. Most thermal cameras operate in the wavelength bands 3-5 $\mu$ m and 8-14 $\mu$ m where the atmospheric transmission is good. Originally intended for military purposes, these devices also find application in astronomy, surveillance, medical imaging, insulation inspection, electronics inspection, chemical imaging, and quality control.

Thermal camera designs developed at the OML are based on a 2D array of bimaterial micro-cantilevers that bend in response



to heat produced by the infrared absorption. The bending is measured by micro-optical methods using a diffraction grating integrated under each pixel. The main advantage of this design is the sub-nanometer sensitivity of the optical readout method. Furthermore, unlike microbolometers, main competitor technology, this device does not have an electrical connection to the substrate, simplifying the fabrication while increasing the thermal isolation performance. Another key advantage is that there is no detector saturation in this type of optical readout, allowing for larger dynamic range compared to other technologies (i.e. can measure several thousand degrees of temperature differences in the observed scene).

The intellectual property rights are licensed to ASELSAN, a large military electronics and electro-optics company in Turkey, who is funding the research [4]. The aim is to fabricate 160x120 arrays that can sense 0.1 C° temperature change in the environment. Onur Ferhanoglu and Fatih Toy are now the main researchers in the project [5-6]. Figure 3 show a single pixel simulation result and microscope picture of a fabricated array. Three options are explored for the microfabrication of the arrays: TÜBİTAK-YİTAL laboratories in Gebze-Turkey using silicon wafers and silicon nitride technology, Middle East Technical University Micro Electronics Technology center (METU-MET) in Ankara-Turkey using quartz wafers and silicon nitride technology, and Georgia Institute of Technology, Microelectronic Research Center (GT-MiRC), USA by one of our PhD students who visited the facility using quartz wafers and Titanium-Nitride on parylene technology. The system performance tests are currently ongoing.

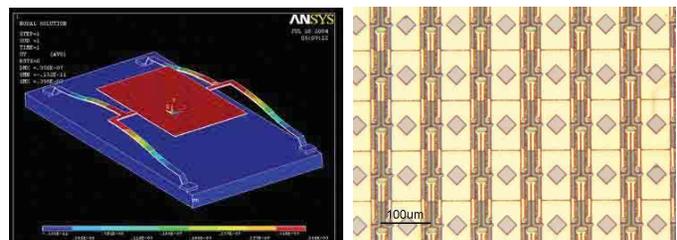


Figure 3: (a) Single pixel model of the thermal detector; (b) Microfabricated array of pixels with integrated diffraction gratings underneath each pixel.

### Ultra-Miniaturized Spectrometer (patented and licensed to Fraunhofer Institute, IPMS, Dresden-Germany)

Infrared (IR) absorption spectroscopy is an established method for the detection and analysis of chemical and biological samples, and used extensively in a wide range of industrial and research oriented applications. Fourier transform spectroscopy (FTS) is one of the numerous IR spectroscopy techniques, distinguished by its unprecedented spectral discrimination paired with the inherent sensitivity, thanks to the throughput and multiplex advantages providing higher SNR and speed compared to other conventional methods like grating or Fabry-Perot spectrometers.

Despite the major decrease in size and increase in integrated software complexity in the last 30 years, these are still large instruments consisting of individual opto-mechanical components, optics, sensors and processing electronics manually assembled in the traditional manner. Furthermore, the output of these spectrometers consists of spectra, which are interpreted either by individuals or by specifically developed algorithms, significantly reducing the throughput. Hence, Fourier transform infrared (FTIR) spectrometers are generally used when size and cost of the equipment are of secondary importance compared to performance.

In principle, FTIR spectrometers could potentially be used as compact and portable sensors or analyzers, but current instrumentation, particularly the scanning mirror mechanisms, do not (yet) fulfill the requirements of a small and easy to use sensor. Such a compact and real-time operating analyzer could be used for monitoring the quality of gasoline at gas stations, the quality and consistency of products (e.g. food and drug industry), the safety in fermentation environment (CO<sub>2</sub>), and countless other out-of-the lab applications.

OML is currently working on a research project focusing on the design, integration, and characterization of a novel miniature FTIR spectrometer with a comb actuated micro-electro-mechanical component constituting its basic building block (Figure 4). The MEMS component utilizes vertical resonant comb drives for actuation, light dispersion, and optical path difference monitoring (Figure 4). This is a novel platform for Fourier spectroscopy developed during the PhD thesis work of Caglar Ataman [7-8]. The patent was licensed to Fraunhofer IPMS, Dresden, Germany, who is partly funding the development project. The fundamental advantages offered by the developed spectrometer system over the existing Fourier spectrometers are high light efficiency (wide clear aperture), mechanical robustness, compactness, ease of fabrication and high integration level. A full FTS system can simply be

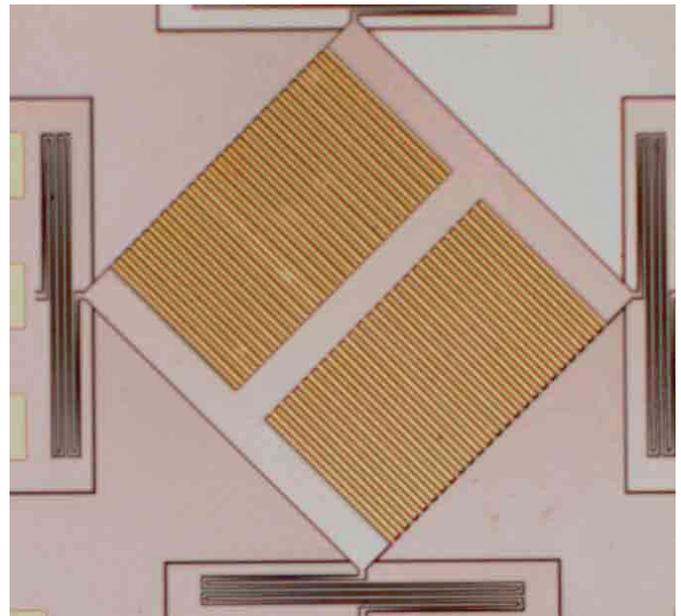


Figure 4: A microscope photograph of the basic MEMS component of the novel FT spectroscopy system.

implemented using the comb-actuated MEMS device, a single detector, and processing electronics. The project recently received a total of 3 Million Euro grant from the 7th framework to develop the technology further with commercial partners.

In conclusion, the optical microsystems developed at OML not only resulted in scientific publications and patents [1-8] but also caught the attention of the industry and lead to many novel applications and product ideas.

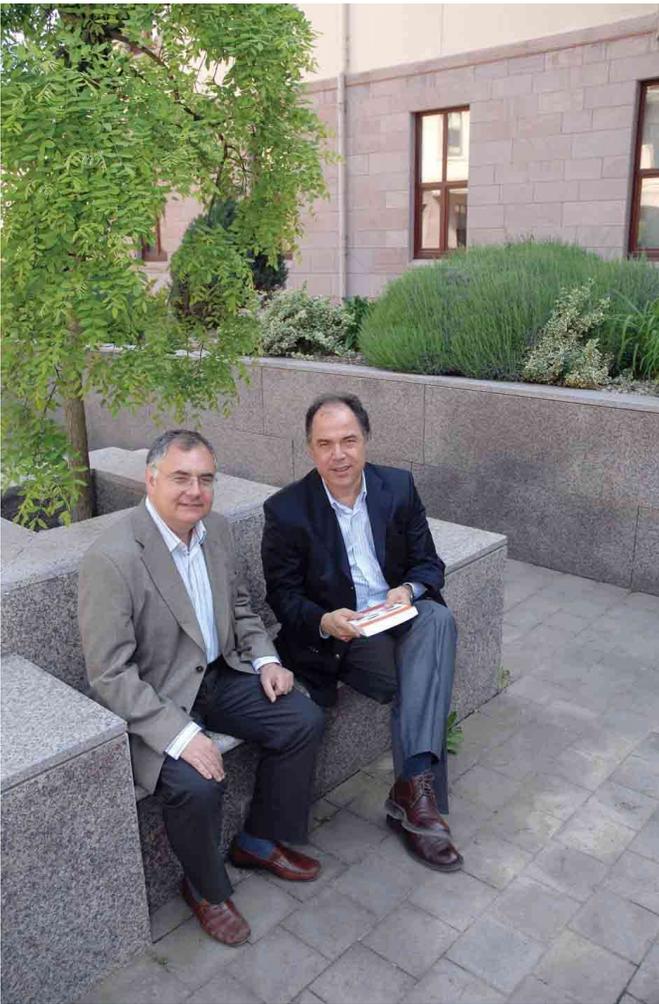
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# Turkish Politics in a Changing World

Our analysis of Turkish politics in a changing world accepts the relevance and importance of existing scholarly works, but nevertheless it aims to go beyond them by paying explicit and systematic attention to the global, regional, national, and local interactions.

E. Fuat Keyman and Ziya Öniş > International Relations



have shaped and conditioned the nature, scope and content of Turkish politics. In doing so, we aim to provide the reader an account of Turkish politics which takes into consideration the far-reaching impacts of global dynamics and domestic transformations in Turkey.

## The Methodological Departure

Much of the serious and scholarly contributions to the study of Turkish politics have tended to focus more on domestic pressures and actors as the fundamental driving forces in Turkish politics (Heper, 1985; Çarkoğlu and Kalaycıoğlu, 2007; Özbudun, 2000; and Sunar, 2004). There is much to learn from these studies concerning Turkish politics and its underlying dynamics. Yet, at the same time, there is a need to re-think Turkish politics at a time when global and regional influences assume increasing importance, making it progressively more difficult to separate domestic politics from international politics and internal from external actors. At a time when “outside” becomes “inside”, we believe that a major effort needs to be made to analyze Turkish politics both theoretically and historically by paying attention to the interplay of global dynamics and domestic transformations. This way of approaching Turkish politics also enables us to go beyond binary oppositions and providing an understanding of Turkish politics that explicitly takes into account the interactions of the global, regional, national and local forces and processes. Furthermore, by locating Turkish politics in between global dynamics and domestic transformations, we are able to transcend the existing accounts based on the center-periphery and the left-right divisions. We suggest that such divisions are still relevant; yet, they need to be rethought and re-conceptualized within the context of global dynamics and their impact on

**T**here have been a set of deep-seated changes and transformations over the course of the past three decades, being felt in every sphere of social life in Turkey. Moreover, these changes and transformations have been generated by both global dynamics and domestic demands and calls for a better, stable and secure Turkey. Our research seeks to analyze the ways in which the processes of change and transformation

At a time when “outside” becomes “inside”, we believe that a major effort needs to be made to analyze Turkish politics both theoretically and historically by paying attention to the interplay of global dynamics and domestic transformations.

domestic transformations. In other words, our analysis of Turkish politics in a changing world accepts the relevance and importance of existing scholarly works, but nevertheless it aims to go beyond them by paying explicit and systematic attention to the global, regional, national, and local interactions.



A quick glance at the recent experience of Turkish politics during the past quarter of a century clearly reveals that both global dynamics in the form of the exposure of the Turkish economy to global market, Turkey's European integration process and the growing security concerns of the post-9/11 world, on the one hand, and the changing nature of Turkish modernity in terms of the emergence of identity politics, civil society organizations and the new demands for enlarged citizenship rights and freedoms, on the other, have given rise to a need to understand Turkish politics at the intersection of inside and outside. This is what we aim to accomplish in our recent book *Turkish Politics in A Changing World: Global Dynamics and Domestic Transformations*. We locate Turkey at the intersection of globalization and modernization. As a matter of fact, in our increasingly global world, the success of political actors in elections has reflected their ability to effectively engage with both the outside-in movement of global dynamics and the bottom-up pressures originating from domestic processes and actors. The continued electoral success of the Justice and Development Party (herewith, the AKP) at a time of serious nationalistic backlash and continued security concerns is clearly consistent with the broad thesis of the present study, namely that effective engagement with globalization is a better recipe for success as opposed to defensive and inward-oriented nationalistic visions.

### Democratic Consolidation and Economic Stability

The history of contemporary Turkey reveals that the processes

of transition to modernity and democracy have been rather successful. The key requirements of political modernity, in the form of the nation state, national developmentalism, bureaucratic and legal-rational framework, and republican citizenship have been firmly established. Furthermore, the transition to modernity in Turkey through revolution from above or the state-based transformation of a traditional society has attracted widespread attention and appreciation to the extent that it has been regarded as a model for modernization in post-colonial and developing societies. Likewise, the transition to democracy in 1945 has been an important success story. Despite regime breakdowns, multi-party, parliamentary democracy has been established as a norm of political life during the past sixty years.

However, the success in transition to modernity and democracy has not translated itself into full consolidation. The state-based transition to modernity has failed to transform itself in such a way as to fully conform to the norms of democratic governance and individual autonomy in terms of rights, freedoms and responsibilities. This has manifested itself in the emergence of identity-based demands for cultural recognition, civil society-based demands for active and participatory citizenship, and citizenship demands for the enlargement of rights, freedoms and responsibilities. In this sense, since the 1980s, and especially the 1990s, Turkey has been experiencing crises and the changing formation of modernity. In the current context, one of the major problems that Turkish politics is confronted with is how to engage with and respond effectively with these crises and changes in modernity. In more precise terms, we suggest that the problem of modernity in Turkey today has little to do with the question of the transition to modernity, but rather more to do with its consolidation in state-society-individual relations.

By similar logic, Turkey needs to be transformed into a more stable, just and democratic social formation meaning that the central problem involves the consolidation of democracy. This, of course, entails both state-society interactions and intra-societal group and identity-based relations. It should be pointed out, however, that our notion of democratization goes beyond procedural and formal understanding of democracy based on political parties and free elections. We differentiate between formal and substantive democracy (Keyman, 2000; Öniş, 2003). By democratization in substantive terms, we mean the deepening and consolidation of democratic norms in social relations which involves the enlargement of the language of rights, freedoms,

responsibilities, tolerance and non-violent resolution of conflicts. In this sense, we suggest that democracy implies not only a political regime, but a type of society in which interactions between and in groups are regulated through democratic norms of individual autonomy, tolerance, and respect for others. Like modernity and its consolidation, we will explore democracy and its consolidation in Turkey.

Indeed, the natural counterpart of the need for democratic consolidation in the economic sphere in Turkey is the problem of achieving sustained economic growth. In spite of the significant improvement in Turkey's economic performance in the aftermath of the 2001 crisis, there are still question marks concerning the robustness and sustainability of the favorable macroeconomic and growth performance. It is possible to identify elements of fragility in Turkey's macroeconomic performance which are likely to come to the surface especially if the unusual boom conditions in global financial markets are reversed in the coming years. Hence, one of our central propositions is that democratic consolidation and the achievement economic growth are the central challenges facing Turkish politics in the current context. Moreover, these two issues are not independent challenges, given that they are very much intertwined. Indeed, democratic consolidation is not only important for its own sake but also for creating the institutional and legal infrastructure and the kind of stable environment needed for sustained economic growth.

**Turkey needs to be transformed into a more stable, just and democratic social formation meaning that the central problem involves the consolidation of democracy.**

In *Turkish Politics in A Changing World: Global Dynamics and Domestic Transformations* we intend to provide the reader with a historical and analytical background account of Turkey from the perspective of democratic consolidation. In this book we prepare the reader for a more detailed analysis of post-1980 developments in Turkish politics and deal with the crises and changes in Turkish politics by focusing on the impact of globalization and the European integration process. In doing so, we pay special attention to the recent deepening of Turkey-EU relations as well as the process of economic restructuring in the context of globalization with the IMF and the EU heavily

involved as the key external actors. Thus, Turkish politics is located at the intersection of global dynamics and domestic pressures.

On the question of governing Turkey our focus emphasis is on the recent AKP experience and the parallel process of the failure of social democracy in Turkey. We contend that one of the manifestations of the crises and change in modernity and democracy as well as the need to consolidate them in state-society-individual relations has been the question of the "center" in Turkish politics.

Finally *Turkish Politics in A Changing World: Global Dynamics and Domestic Transformations* focuses on societal dynamics and actors operating at the intersection of modernity and democracy. Here, we analyze the development of civil society in Turkey, the question of identity in the context of the Kurdish problem and the question of social justice in the form of inequality and poverty. We hope that these studies in total will provide a broad and coherent picture of change and transformation in Turkey and how Turkish politics has responded to these underlying changes. Thus, *Turkish Politics in a Changing World*, presents a study of contemporary Turkey from the standpoint of democratic consolidation and in doing so provide a historical, sociological and political-economic analysis of Turkish politics by methodologically locating the governing of Turkey at the intersection of global-regional-national-local interactions.

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# Rumi in Love

Rumi spent his life in the pursuit of Truth (hakikat) and moral integrity.

Hülya Durudoğan > Philosophy

**T**he great mystic Mawlana Jalal al-Din Rumi (1207-1273 A.D.) spent most of his life in Konya, a city within the westernmost territories of Seljuk Empire. Rumi's first name, "Mawlana" means "our Master" in Arabic, and was traditionally a title given to Muslim scholars. But due to the great fame Rumi acquired, this respectful title later on came to refer only to him.

As Evelyn Underhill, who worked extensively on Christian mysticism, explains in the preface of her book *Mysticism: A Study in Nature and Development of Spiritual Consciousness*, mysticism is:



The expression of the innate tendency of the human spirit towards complete harmony with the transcendental order; whatever be the theological formula under which that order is understood. This tendency, in great mystics, gradually captures the whole field of consciousness; it dominates their life and, in the experience called "mystical union" attains its end. Whether that end be called the God of Christianity, the World-soul of Pantheism, the Absolute of Philosophy, the desire to attain it and the movement towards it, 'so long as this is a genuine life process and not an intellectual speculation' is the proper subject of mysticism. I believe this movement to represent the true line of development of the highest form of human consciousness.

Especially according to some mystics, it follows from the ineffability of Ultimate Reality that its nature cannot be revealed by philosophy, science or even by reason itself, considered to be the most reliable source of conscious acts. What is needed is a spiritual experience depending neither upon sensual nor upon purely rational methods. But then how are we or the mystics to find their way through that experience if not lead by reason, the safest method as yet known to man? The answer is love. Only love (as the key to the wisdom of the heart) as opposed to reason (as the key to the wisdom of the mind) can give us insights regarding the nature of the mystic's very personal and unique desire to unite with God or the Beloved as He is sometimes called among the mystics. In this new light, mysticism can be defined as the love of the Absolute. It is love that paves the way for the ultimate stage of the mystical experience, the one that is generally known under the name of unio mystica or the mystical union with God.

Rumi's philosophy of life and his works reveal that he was a devoted follower of Prophet Mohammed's teachings as well as a very pious Muslim. The mystical quest for the divine almost always takes place within a prescribed religious tradition. His own family belonged to the Hanafi school of Islamic law, one of the four orthodox traditions of the Sunni branch of Islam. In his works, there are many places where he voices traditional Islamic beliefs on diverse topics. However, Rumi advised

believers not to be a blind follower of rituals, since real devoutness must take place in the heart and not in the form. Rumi emphasizes that blind memorizing and reciting of the prayers are not what elevates the soul and makes it possible to unite with the Beloved, that is, God. Accordingly, the function of the religious rituals is only to help the believer concentrate on the mystical search of God. Whereas instruction is necessary, it is not by itself sufficient to elevate the soul. As advised by Rumi, one needs to go beyond the practice of rituals and instruction for the mystical intuition to overwhelm the soul. According to Rumi, one needs to efface one's nafs and enter a state of complete submission to God's commands and will. This state of complete surrender to the will of God is called tawakkul.

We can notice a threefold model in Sufism:

- the body;
- the lower soul (known in Sufism as the nafs, the "self");
- the higher soul or spirit (known in Sufism as the *ruh*).

According to the Sufis, just as the form of the universe and everything within it manifest a hidden meaning, so does the human form. Although Rumi distinguishes the body from the soul and claims that the body or form is a prison from which the soul must escape, he cannot dismiss of the body altogether since the body is the only outward manifestation of the spirit in this world. The lower soul or nafs, is referred to as the animal soul. Since nafs has a negative connotation as opposed to soul in English, we should note that nafs can best be translated as the "ego" to reflect this negative meaning. This animal spirit comes into being with the body and like the body comes to an end. The higher soul or ruh is the highest level of the spirit and belongs to the saints, the prophets and philosophers.

This higher soul is reached by truly vanquishing the ego and escaping the "prison" of the body, or in other words, by "dying before dying." In Rumi, the two aspects of the soul-as *nafs* and *ruh*-clearly enable us to understand the mystical idea of the immortality of the soul. Accordingly, as *nafs*, the soul is concerned with the earthly needs and desires of the body (only as long as there is "life" in the body) to later perish with the body; while *ruh* is the soul as it partakes in the divine nature. Thus respectively, the soul as *nafs* can be said to be mortal while the soul as *ruh* is immortal. This may in turn raise the question as to how the same thing, i.e. the soul, can both be mortal and immortal. I believe that this dilemma can be resolved if we concentrate on the intuition that "dying before dying" makes possible. As the mystical awareness requires that one "dies" before (actually) dying, it resolves this dilemma through a state of consciousness that can only be possible through the love that one has for the Divine. As the mortal beings that humans are, they can nevertheless grasp the immortality of *ruh*



that is necessary in order to understand a sort of consciousness that makes the reunion with God possible before one actually dies. Moreover, this consciousness that overwhelms one, as one becomes mad with the love of God, is possible during one's life time. In other words, as one's heart fills with the love of God, the *nafs* disappears. When the mystic reaches a state where he/she dies before dying, the divine aspect of the soul which is *ruh* dominates over the other aspect, i.e. *nafs*, to bury it before the actual death happens. Hence, there is no contradiction, but rather opposition of inclinations. As the soul is mysteriously compelled to follow what the "heart in love" demands, the immortal soul, that is to say *ruh*, starts to dominate one's whole being. Ultimately, such a one will no longer care about the demands of the mortal soul (*nafs*) and hence "die before dying." Accordingly, immortality in the sense that mystics are using the term can only be gained when one dies before one dies. This means that one actually dies, since this "becoming one" with God is only possible through a sort of consciousness. In other words, the immortality of the soul is not analogous to the mortality of the body. It is not because the soul is not a material substance (that is to say, it is not of the sort of matter that perishes), like the body is, that makes it immortal. Immortality of the soul refers to a peculiar sort of wisdom as a state of consciousness that a person, whose heart or mind is ever occupied with the love of God, reaches while in flesh and blood.

At this point, we need to address the mystical sense in which we speak of the immortality of the soul in a deeper context. I believe that although Rumi was very much influenced by the

Islamic teaching, his insight exceeds the bounds of theology. Namely, we must conceptualize love in a genuinely philosophical sense in order to gain access to Rumi's thought as it exceeds the bounds of theology. The fundamental distinction between human desire and the love that leads to the consciousness of the immortality of the soul is this: only ecstatic love, love that enables the human being to transcend his or her egoistic self, is capable of allowing the intuition of oneness with the Divine, and that accounts for the experience of "dying before dying." In this case, it is not merely a matter of blind faith or of religious doctrine that he/she realizes his/her innermost self while still in flesh in blood, but a feeling even more convincing that the feeling of pain upon being burned by fire. His/her heart (or mind) really does partake in the eternal nature of God, the Beloved. This is not something that we can posit in terms of a theory, but we can "live" and "dwell" in the consciousness of the immortality of the soul.

From many clues in his works as well as some explicit statements, we understand that for Rumi, the world means "exile." In the opening verses of his masterpiece, the *Mesnevi*, Rumi employs a metaphor to convey this mystical intuition. The metaphor involves a reed-flute (*ney*) that has been made of a piece of reed. With every breath into the flute, the flute longs for its home, the reed-bed from where it has been ripped off. Similarly, according to Rumi, every human being longs for the original unity with the Beloved, God. The *ruh* (the higher soul) laments on the account of being torn away from the oneness (with God) and longs to get rid of the body and unite once more with the Beloved. The one who lives with the constant awareness of his/her true nature, who ever strives to get rid of the *nafs* (ego) in order to become one with the Divine is called *insan-ı kamil* in the sufi tradition. Rumi writes: "There is another soul, seek out for it. There is a treasure in the Mount Body, seek out for that treasure. O mystic who goes on! If you are really capable then seek. Not outside, but seek what you are seeking for in yourself." As Self-knowledge is the key to come closest to the utmost Reality or God, it is of utmost necessity that the person or the mystic aiming for self-knowledge leaves his/her ego totally and without reservation. As is the case for most mystics, for Rumi too the world is a dream, a prison as well as a veil over Reality. Rumi draws a fundamental distinction between form (*suret*) and meaning (*mana*), or appearance and reality. In this context, form is one's outward appearance whereas meaning defines one's inward and unseen reality. Ultimately, meaning reflects one's true nature as it is

known to God Himself. Moreover, since God is the universal author of everything, it is also He who is the author of the perfect unity, of all meaning and of all reality. Thus Rumi concludes that in the last analysis, the meaning of all things is God.

Rumi spent his life in the pursuit of Truth (*hakikat*) and moral integrity. Similarly, he never considered death as if it amounted to nothingness or nonexistence. As one grasps that death is the returning back to one's own eternal essence, one better realizes that there is no death for such a one. Death cannot be nonexistence; on the contrary, death is a rebirth to the eternal life. Since Rumi was a devoted Muslim, death, moreover, meant reunion with God who was Himself the Truth. Referring to death, Rumi says: "everyone spoke about parting and me, I spoke about reunion." Accordingly, Rumi's death in mid-December of the year 1273-called *şeb-i aruz*-is considered his "wedding night," the night he departed this earthly life and was finally united in love with God.

Finally, as much as mystics may strive to uncover the divine within, they can only go as far as a mortal being endowed with a physical aspect can go to become more "god-like." Mystics have no choice but to strive for spiritual growth "in flesh and blood." Indeed, if human beings were pure souls, the mystical effort to get rid of the self in order to become one with God would be groundless since they would already be selfless. The understanding that the body and the mind cannot be completely separated and that one reaches spiritual awareness while in a body shows itself beautifully as this oneness manifests itself in the dances of Whirling Dervishes. In a state of intense ecstasy, the Sufis belonging to the Mawlawi order (founded by Rumi), practiced whirling as a form of *dhikr*, that is to say remembrance of God.

I would like to conclude the paper with the following very famous verses by Rumi, which I believe to beautifully depict Love as the mysterious power transforming one into a helplessly dedicated mystic.

My mother is love,  
My father is love,  
My prophet is love,  
My God is love,  
I am a child of love,  
I have come only to speak of love.

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<sup>1</sup>Rumi (1979) "Rubais" in: *Mystical Poems of Rumi*, translated by A.J. Arberry, p. 22 (Colorado: Westview Press).

<sup>2</sup>The original reads: "herkes ayrılıktan bahsetti, ben vuslattan." The translation is mine.

# Quantum Optics with Bose-Einstein Condensates

Research efforts on quantum optical properties of atomic Bose-Einstein condensates were started at Koç University at 2002 with the objective of contributing development of quantum information science and technology.

Özgür E. Müstecaplıoğlu > Physics

**R**ichard Feynman (1918-1988), a famous American physicist, believed that if, in some cataclysm, all of scientific knowledge were to be destroyed, and only one sentence passed on to the next generation of creatures, the statement that would contain the most information in the fewest words is the atomic hypothesis that “All things are made of atoms—little particles that move around in perpetual motion, attracting each other when they are a little distance apart, but repelling upon being squeezed into one another”. In that one sentence an enormous amount of information about the world is packed, if just a little imagination and thinking are applied.

Light is a particular electromagnetic radiation, visible to human eye, corresponding to the wavelengths about 400 – 700 nanometers (one nanometer is one billionth of a meter). The wavelength of the light determines its electromagnetic energy. Different colors of light correspond to different wavelengths. Following R. Feynman, one can imagine light could only come from atoms. Generation of light is indeed due to emission of electromagnetic radiation by atoms. Similarly, the destruction or absorption of light is nothing but the conversion of electromagnetic energy back to the atom. On the other hand, description of light generation and absorption requires quantum model of atom, where atom can only receive discrete units of energy, and thus emit or absorb light at certain wavelengths.

Once the light is generated, it would propagate till it is absorbed. Many applications in early optics are based upon modifications in the light path via optical elements such as mirrors, beam splitters, optical lenses and prisms. Their effects on the light trajectory can be explained by the geometric optics where the light is visualized by optical rays. In precision measurement applications, or in more modern applications such as three-

dimensional imaging and holography where interference, diffraction and polarization of light are needed, physical optics that describes light as a wave is used. In general, when the light sources, where the light is generated, and detectors, where the light is destroyed, are ignored and the light propagation is described either as a wave or a ray, this framework is called classical optics. When the sources and detectors are included and are treated quantum mechanically, while the light is still treated classically, such a framework is called as a semi-classical optics.

After the quantum model of black body radiation by M. Planck was developed in 1901, and the photoelectric effect was interpreted by A. Einstein in 1905 in terms of light quanta, or photons, a modern version of Sir I. Newton’s corpuscular theory of light is firmly established. In accordance with the wave-particle duality, it is sufficient to consider light as a wave and ignore its quantum nature as long as a specific experiment or a natural phenomena can be explained in terms of a wave description. Hence, in parallel with the early optical applications, classical optics was sufficient to use.

Quite recently, it was found that extremely low light intensities, in particular single photons, offer tremendous advantages in the area of communication. Quantum optics treats the light as a photon flow and studies their distribution, or statistics, as particles. Quantum statistical properties of radiation are closely related to the quantum noise and thus, quantum optical studies reveal how to manipulate quantum noise. A major achievement of quantum optics was the demonstration of squeezed light, where quantum noise, or fluctuations, in the intensity or the phase of the light could be reduced below the standard limits. Early experimental and physical systems where quantum optics was applied were

optical cavities, interferometers, and trapped atoms and ions. Advances in atom trapping technology have been combined with developments of powerful atom cooling techniques. This led to dramatic demonstration of Bose-Einstein condensation of an atomic cloud in 1995. A Bose-Einstein condensate (BEC) is a gaseous state where all the gas particles reside in the same quantum state. BEC provides scientists an unprecedented ability, to observe and control quantum phenomena on a large scale. BEC was considered to be the holy grail of atomic physics. Many systems and methods are tried in vain before the eventual success. The celebrated BEC was achieved in a gas of sodium atoms magnetically trapped and laser-cooled down to about absolute zero temperatures. The final set-up, the holy grail of atomic physics, held the BEC in it as a beautiful distillation of many ideas and methods tried before. Ever since its realization, which is awarded by the Nobel Prize, BEC continues to distill various scientific disciplines. Condensed matter physics, solid state physics, and optics are major fields of study in BECs. Interaction of light with BEC led to novel light propagation and interaction regimes and became an exciting field of study.

Initial investigations of quantum optical properties of condensates aim to characterize quantum statistical nature of the condensate. For that aim, it was necessary to study photon scattering from the BECs. In addition to Raman scattering or Bragg scattering, it was demonstrated that celebrated superradiance effect of quantum optics could also be realized in BECs.

BEC is very similar to laser light regarding its coherence properties. All atoms being in the same state can be described by an order parameter, playing the role of laser intensity and the phase. This imagination opened the field of atom laser studies, a massive analog of optical laser. Mixing matter waves and light turned out to be possible and effects that were available for light before, now experimentally realized for matter waves.

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Analogous to nonlinear optics, matter wave solitons were demonstrated in matter wave optics. BEC also became an intriguing medium for the light propagation. In contrast to nonlinear optics where strong intensities are demanded, BEC permits to observe nonlinear effects, such as wave-mixing, at single photon level. This is proposed to generate highly correlated photon states, so called quantum entangled photons. These are resources for quantum information applications. It was demonstrated that light can be stopped or brought to crawling speeds within the BEC. Furthermore, it was shown that entire information of the light can be mapped on BEC, which could be carried to somewhere else and on demand, exactly the same light could be re-generated out of it. Such unprecedented control over light and matter interaction is essential to build atom-optical interfaces for potential quantum computers and long-distance quantum communication networks.

Motivated by these state of the art applications and developments in the quantum optics in the Holy Grail of atomic physics, research efforts on quantum optical properties of atomic Bose-Einstein condensates were initiated at Koç University in 2002. Financial support had been provided by Turkish Academy of Sciences (TÜBA) under the Distinguished Young Scientist Program (GEBİP) from 2004 to 2007. After recent establishment of MS program in physics, one MS student of Koç University took part in the research endeavors. Students trained in this field are highly sought abroad. Our MS student received acceptance from several top ten universities in United States, and chose to go to the Cornell University. Currently one PhD student in the Materials Science Graduate School and one MS student in the physics department have just started to get

training to contribute to the research objectives. We hope to train more students in this exciting field after opening a PhD program in physics this year.

Main objective of the quantum optics with Bose-Einstein condensate research is to utilize these

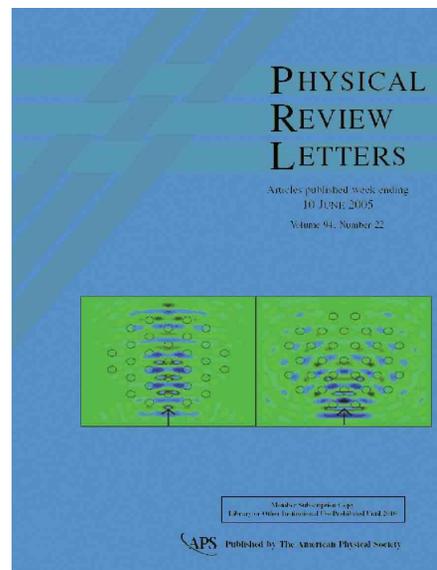


Figure 1: A vortex lattice can stop light by building up forbidden energy regions, analogous to photonic crystals.

Students trained in this field are highly sought abroad, and Koç University provides excellent world-class education on this subject.

novel systems for quantum information science and technology applications. Among these, quantum optical memories for long-distance quantum communication and quantum entanglement generation and manipulation for quantum information processing attract much attention. Koç University atomic physics and quantum optics research efforts were received world-wide recognition as a result of solid achievements obtained here.

In a recent project, together with Prof. Tekin Dereli of Koç University Physics Department, we have discovered a novel quantum decoherence mechanism that would limit the life times of quantum information units (qubits) in atomic Bose-Einstein condensates. Our Physical Review A publication was selected to appear in the prestigious Virtual Journal of Quantum Information, (Edited by D.P. DiVincenzo) in 2007.

Another serious mechanism of decoherence is radiative losses in atomic systems. To eliminate this we could use photonic crystals which can exhibit band gaps to forbid radiation. We have shown that an atomic Bose-Einstein condensate, if rotated, would support a regular array of vortices. Such a vortex lattice demonstrates photonic band gaps as in solid crystals. This curious result was announced to the physics community from the cover of Physical Review Letters.

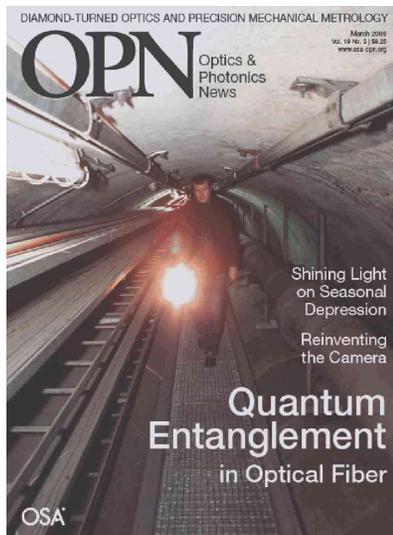


Figure 2: An overview of quantum entanglement for long-distance communication is given as the cover article for March 2008 issue of OPN journal.

we have formulated a three-dimensional light propagation theory for atomic condensates with a PhD student from Istanbul Technical University. Our recent results were published in Optics Letters. This work was also supported by İstanbul Technical University Foundation. Our article was selected to be the cover story of the March 2008 issue of Optics and Photonics News.

Researchers and their students from various national and international institutes collaborate with us to achieve our research objectives. We have worked with Prof. E. Demiralp of Bogazici University on atom-chip problem. We have found that using tight dimple-shaped traps within larger traps to confine Bose-Einstein condensates allows for condensation with smaller size and higher density. Such miniature condensates are highly sought for atom-chip applications. An analog of spintronic device, atomic Josephson junction with spin carrying atoms, was examined in collaboration with Dr. W. Zhang of Ames Laboratory and Prof. Li You of Georgia Institute of Technology. Quantum transport of spin carrying matter wave solitons was also investigated. Such massive analogs of optical fibers and atomic analogs of Josephson junctions are demanded for integrated atom-optical quantum information processing and transfer.

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# Koç-IBM Supply Chain Research Center

The goal of the Supply Chain Research Center is to develop novel approaches to supply chain management and logistics that include consideration of sustainability and humanitarian aspects in addition to traditional financial objectives.

F. Sibel Salman - Metin Türkay > Industrial Engineering

We concentrate our research effort to develop models and solution algorithm with the objective of establishing sustainable supply chain and logistics systems. Our effort has been recognized by IBM Corporation. Koç University became the first Turkish university to be awarded the IBM Shared University Research Award that is offered annually to a limited number of universities world-wide to promote projects on the frontiers of science and technology. The project proposed by Industrial Engineering faculty member Assoc. Prof. Metin Türkay on Innovation in Supply Chain is the only recipient of this prestigious award in Turkey. In addition, Koç-IBM Supply Chain Research Center will be established in the College of Engineering for future research projects coordinated by Assoc. Prof. Metin Türkay and Asst. Prof. Sibel Salman with IBM Turkey University Relations Manager Jale Akyel.

Supply chain management is the process of planning, implementing, and controlling the operations of the complex

supply chain networks that includes supplier, production centers, distribution centers, retailers and customers with the purpose of satisfying customer requirements as efficiently as possible. Supply chain management includes the planning and management of in sourcing, procurement, production and logistics activities as well as the coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers.

The main objective of supply chain systems has been to satisfy the customer demand to maximize the financial gains from the operations of the supply chain. The financial concerns primarily include: the cost of raw material purchasing from the suppliers, the production cost at the production/manufacturing centers, the inventory and material handling costs at the distribution centers, the cost of customer service at the retailers and the cost of transportation incurred by the movement of material/goods throughout the supply chain system and the revenue generated from the customers as shown in Figure 1.

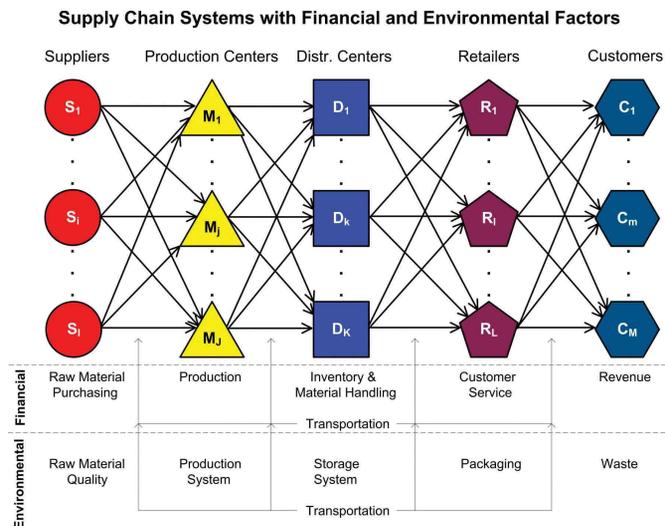


Figure 1 - Schematic representation of supply chain networks with financial flows and environmental effects.

An efficient and responsive supply chain system needs to include environmental and social considerations for sustainability. The environmental performance of supply chain and logistics systems can be achieved by focusing on better management of resources available in the supply chain. The quality of raw materials has significant effects on the environmental performance of the supply chain systems. Raw materials contain impurities that may be harmful to the environment. The production systems usually generate waste in gaseous, liquid or solid form although some of this waste is treated, majority of the waste is released to the environment.

The storage and material handling systems at the distribution centers generate environmentally harmful substances during their operation. The retailers usually sell the products in packages

that are attractive to the customers. Majority of the packaging material usually ends up in nature without properly being recycled or treated in waste disposal facilities. The customer generates waste after consuming the products. The waste from the product is usually harmful to the environment. The transportation system also generates environmentally harmful substances through emissions from the vehicles. Social aspects of supply chain systems include generation of value and distribution of this value to different segments of the population, minimizing the risks of operations to the population and responding to disasters effectively and on a timely manner. We can achieve sustainability of supply chain systems by integrating financial, environmental and social objectives seamlessly.

We examine the environmental issues in supply chain systems in three categories:

1. Product centric approaches (closed loop supply chains),
2. Production system centric approaches (environmentally conscious production),
3. Transportation system centric approaches (sustainable transportation).

The product centric approaches focus on the design of the product for minimizing the use of environmentally harmful materials in the product and the recovery and reuse of the product after it has been consumed by the end user. The objective in the product centric approaches is to eliminate the product becoming a waste after the product has completed its life time. These approaches include closed loop supply chains where the product is recovered for reuse/recycle and reverse logistics that includes the planning of the logistics infrastructure of the products.

The production system centric approaches consider the selection of raw materials and the design of the production systems for minimizing the environmental impact. The objective of the production system centric approaches is to design the production system so that the production system is flexible enough to eliminate or reduce the generation of waste. One of the mechanisms is the use of different raw materials. Other mechanisms include changing the configuration of the equipment or the operating conditions of the process system to reduce generation of waste.

Transportation centric approaches consider the use of different transportation systems that would reduce the environmental effects. For example, whenever possible using rail or sea transportation could reduce the emission of Green House Gases. Another aspect of transportation centric approaches is the humanitarian logistics. Disasters, either natural or man-made,

pose significant threats to societies. They have the potential to cause severe human and economic loss, and to disrupt the day-to-day activities of humans by crippling the functionality of critical infrastructures and service systems. These infrastructures include habitats, industrial structures, and engineering lifelines such as transportation networks, power systems, water networks, and communication networks. The essential service systems affected may include among others the medical services, food and consumer product distribution networks, financial markets, and mail delivery. The functionality of infrastructure networks is critical for effective disaster mitigation and response. While these networks are vulnerable to failure under natural or man-made disasters, their vulnerability can be reduced by engineering activities that enhance their components structurally leading to higher survival probabilities.

The goal of the Supply Chain Research Center is to develop novel approaches to supply chain management and logistics that include consideration of sustainability and humanitarian aspects in addition to traditional financial objectives. The modeling approaches and solution algorithms developed in the center will be applied in a number of projects to determine their feasibility and potential benefits. In addition, one of the activities of the center is to prepare new course contents that will be taught at universities world-wide to promote this approach to sustainability. Currently, the sustainability and humanitarian aspects of supply chain management and logistics is being applied on four different projects with the participation of undergraduate and graduate students as well as doctoral candidates. The details of these projects are as follows:

**Sustainable Energy Supply Chain:** Energy, a necessity for modern life, is vastly consumed in the industrial commercial and service sectors as well as in social activities. Unfortunately, a majority of this energy comes from the widespread use of fossil fuels that causes considerable detrimental effects to the environment. Energy production systems are traditionally based on burning fossil fuels emitting greenhouse gases that contribute to global warming.

This project, sponsored by TÜBİTAK, aims to address sustainability of energy supply chains by considering techno-economic analysis of emerging energy production methods, development of mathematical models and optimization algorithms. The development of simulation and optimization models for carbon capture and sequestering systems that will be a major approach to curbing carbon emission in the near future had been completed. In addition, modeling and optimization studies to integrate bio-fuels into energy supply chains have been completed.

Development of techno-economic models for photovoltaic cells used to convert solar energy into electricity is under study. Last, development of algorithms to solve mixed-integer multi-objective optimization problems is being addressed. The models and solution algorithms developed in this project will be used to analyze sustainable energy supply chains through optimization and scenario studies.



**Disaster Logistics:** Every year, around 500 natural or man-made disasters affect 200 million people, causes around 75,000 deaths, and material damage that is measured in billions of dollars. The human and economic losses can be reduced by improved planning, preparations, and coordination. Disaster Logistics focuses on undertaking the necessary planning and precautionary steps to respond to a disaster. During the pre-disaster phase, relief supplies such as dry food and blankets should be stored at critical points, coordination and distribution plans should be established based

on possible disaster scenarios. We are all aware that Istanbul faces the risk of being hit by a serious earthquake. A scientific study published in 2000 estimated that the possibility of experiencing a strong earthquake in Istanbul is  $62.6 \pm 15\%$  over a 30 year period. Earthquake scenarios and damage estimates developed in 2003 propose 30-40 thousand fatalities, 120.000 heavy injuries and 1.2 million homeless people, indicating the magnitude of the required logistics activities. To coordinate the post-disaster logistics activities, several Disaster Response and Distribution Centers (DRDC) are planned to be built by the Istanbul Metropolitan Municipality (IMM) throughout the city.

This project, which is sponsored by the IMM Disaster Coordination Center, develops methods for the selection of the locations of these centers. In selecting the locations, the first factor to be taken into consideration is the ability to distribute supplies effectively in the event of a disaster. The objective is to reach the maximum number of victims within the shortest time. We developed a mathematical model to find the DRDC locations that minimize the weighted time to distribute supplies to affected residential areas while making sure each affected area is close enough to a DRDC. Using damage estimates, the inputs of the mathematical modeling have been generated from the collected data and several DRDC locations have been identified out of the 39 potential areas. We are working on identifying the amount of relief items to be stocked at the facilities as well as the suppliers of these facilities. One more problem is on identifying post-disaster travel times. We are also analyzing the required capacity and location of field hospitals to be built in affected areas.



**Inter-Modal Transportation and the Use of Ro-La System in Marmaray:** One of the most important steps in logistics is transportation that uses different diverse modes including sea, rail, road, air and pipeline. Some of these modes are economical while others have the advantage of being more environmentally

friendly. This project involves modeling and optimization in the design and operation of inter-modal transportation systems. The project is supported by TÜBİTAK and Istanbul Metropolitan Municipality. The objective in this project is to develop scheduling and facilities planning models to integrate capacity planning with the operations. These models are being used to analyze the establishment of Ro-La system in Marmaray.

**Automotive Logistics Planning in Marmara Region:** The Marmara region requires significant logistics improvements in order to meet the transportation demand in supplying raw materials and spare parts to its automotive manufacturing industry, and to effectively transfer finished goods to demand points in different parts of the globe. The objective of this project, which is supported by the Automotive Industry Association, is to analyze the current logistics infrastructure and provide insights into establishments of a sustainable logistics system for automotive industry in the Marmara region.

In addition to these projects, we are planning to start two new projects in the near future:

**Establishing a Reverse Logistics System and a Recovery Facility for Used Batteries:** Batteries are used to power many electronic devices. After the energy content of batteries is depleted, they are disposed of in landfills that greatly harm the environment for centuries. This problem can be reduced by initiating city-wide recycling programs and facilities to recover useful metals in batteries without harming the environment. This project is supported by both TÜBİTAK Marmara Research Center, Ministry of Environment and Istanbul Metropolitan Municipality. In this project, mathematical models will be developed and optimization studies will be conducted to design a reverse logistics system for batteries. In addition, a recycling facility for batteries will be designed to extract useful materials from used batteries and recycle back them to industrial use. The production planning and scheduling for the constructed facility will also be addressed. Eventually, a waste battery recycling facility will be built and operated in the near future in Istanbul.

**Optimization of Water Consumption in Boron Plants:** Large quantities of water is consumed during the mining and processing of the boron mineral which is one of Turkey's leading industrial minerals. It is important to improve the mining technologies to reduce water consumption and also develop efficient systems for recycling water during operations in boron processing plants for sustainability. This project in collaboration with Eti Mining General Management and

TÜBİTAK Marmara Research Center intends to design an efficient water usage network which limits water usage by minimizing fresh water consumption and generation of waste water in boron mining and processing facilities.

Supply chain management and logistics is a central theme for industrial and commercial sectors. Due to the accelerating pace of globalization, the financial, environmental and social effects of supply chain and logistics systems are observed at every corner of the globe creating concern regarding sustainability of these systems. Sustainability of supply chain and logistics systems can be achieved by an integrated analysis of financial, environmental and social objectives. The Koç-IBM Supply Chain Research Center seeks innovative approaches for modeling, optimizing, and analyzing sustainable supply chain and logistics systems. The methods developed at the center will be applied in real life problems illustrating their effectiveness.

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# Annual Faculty Awards and Honors

**H.FUNDA YAĞCI ACAR** was the recipient of 2008 L'OREAL Turkey National Fellowship for Women in Science.

**LERZAN AKSOY** received the 2007 Werner-von-Siemens Excellence Award for Science and Innovation.

**LERZAN AKSOY** received the Scientific Leadership Award sponsored by Junior Chamber International.

**LERZAN AKSOY** received the MSI H.Paul Root Award cosponsored by the American Marketing Association and Marketing Science Institute for her significant contributions to the advancement of the practice of marketing with her paper appeared in Journal of Marketing.

**İRŞADI AKSUN** received the 2007 Science Award in the field of Electrical and Electronics Engineering from the Scientific and Technical Research and Technology Council of Turkey (TÜBİTAK).

**EMRE ALKAN** received "Distinguished Young Scholar Award" of Turkish Academy of Sciences (TÜBA-GEBİP) in the field of Mathematics.

**TUĞRUL ANSAY** received Medal of Honour, 1st Grade of the Federal Republic of Germany.

**NİHAT BERKER** received the Humboldt Research Award given by Alexander von Humboldt Foundation in Germany.

**SELVA DEMİRALP CUDA** received "Distinguished Young Scholar Award" of Turkish Academy of Sciences (TÜBA-GEBİP) in the field of Economics.

**ALPER DEMİR** was the recipient of TÜBİTAK Encouragement Award in the field of Electrical and Electronics Engineering.

**ALPER ERDOĞAN** received the 2007

Werner-von-Siemens Excellence Award for Science and Innovation.

**ALPER ERDOĞAN** received "Distinguished Young Scholar Award" of Turkish Academy of Sciences (TÜBA-GEBİP) in the field of Electrical and Electronics Engineering.

**ENGİN ERZİN, YÜCEL YEMEZ** and **A. MURAT TEKALP** were the recipients of ICASSP '2007 Student Paper Contest Second Paper Winner Award with their student Emre Sargin.

**ÖZDEN GÜR ALİ** received the Chris Voss Highly Commended Award at the EurOMA 2007 Conference for the paper Profit Maximizing Pharmacy Decision and Pharmacy Discounts in Turkey with her student Burak Çavdaroğlu.

**ZEYNEP GÜRHAN CANLI** received the Young Contributor Award with her 2006 Journal of Consumer Psychology paper "The Effect of Corporate Social Responsibility (CSR) Activities on Companies with Bad Reputations" with Y. Yoon and N. Schwarz.

**ÇİĞDEM KAĞITÇIBAŞI** received 2007 William Thierry Preyer Award for Excellence in Research on Human Development.

**ÇİĞDEM KAĞITÇIBAŞI** received the 2007 Ursula Gielen Global Psychology Book Award with her co-authored book, "Families Across Cultures: a 30-Nation Psychological Study"

**FİKRİ KARAESMEN** received "Distinguished Young Scholar Award" of Turkish Academy of Sciences (TÜBA-GEBİP).

**İSMAİL LAZOĞLU** received The Second Best Oral Presentation Award in the 9th National Congress of Turkish Society of Cardiovascular Surgery.

**MIKE MEITZ** received 2008 Arnberg

Prize of the Royal Swedish Academy of Sciences.

**ALİ MOSTAFAZADEH** received the 2007 Science Award (in Mathematical Physics) from the Scientific and Technical Research and Technology Council of Turkey (TÜBİTAK).

**ALİ MOSTAFAZADEH** was honored with principal membership of Turkish Academy of Sciences (TÜBA).

**ÖZGÜR MÜSTECAPLIOĞLU** was the recipient of TÜBİTAK "Encouragement Award" in the field of Physics.

**OĞUZ SUNAY** and his graduate student Çağdaş Atıcı received Turkcell Mobile Future Competition, Best Academic Study, 2007.

**SERDAR TAŞIRAN** received "Distinguished Young Scholar Award" of Turkish Academy of Sciences (TÜBA-GEBİP) in the field of Computer Engineering.

**MURAT TEKALP** was honored with principal membership of Turkish Academy of Sciences (TÜBA).

**METİN TÜRKAY** received the IBM Shared University Research Award to start the KU-IBM Research Center on Supply Chains.

**HAKAN ÜREY** received 2007 "Distinguished Young Scholar Award" of Turkish Academy of Sciences (TÜBA-GEBİP) in the field of Electrical and Electronics Engineering.

**ŞUHNAZ YILMAZ** received 2007 Sakıp Sabancı International Research Award granted jointly by the Brookings Institute and Sabancı University.

**ŞUHNAZ YILMAZ** received "Distinguished Young Scholar Award" of Turkish Academy of Sciences (TÜBA-GEBİP) in the field of International Relations.

# Turkish Academy of Sciences (TÜBA) Members

## Principal Members

- Ali Mostafazadeh (Mathematics)
- Ali Ülger (Mathematics)
- Attila Aşkar (Applied Mathematics)
- Burak Erman (Chemistry)
- Çiğdem Kağıtçıbaşı (Psychology)
- Ersin Yurtsever (Chemistry)
- Murat Tekalp (Electrical & Electronics Engineering)
- Nihat Berker (Physics)
- Tekin Dereli (Physics)
- Yaman Arkun (Chemical Engineering)

## Associate Members

- Alphan Sennaroğlu (Physics)
- Levent Demirel (Chemistry)
- Sami Gülgöz (Psychology)



# Koç University Profile

Koç University is a private, nonprofit institution, founded in 1993 and located in Istanbul. The University is supported by the financial resources of the Vehbi Koç Foundation. The University's mission is to produce the most capable graduates by providing a world-class education, to advance the frontiers of knowledge by excellence in research and to contribute to the benefit of Turkey and humanity at large. The medium of instruction at Koç University is English. The enrollment in 2008 is 3700, of which 3300 are undergraduate and 400 are graduate students. Number of full-time equivalent faculty is 274.

The educational philosophy of Koç University is based on the principle of "creative teaching/participatory learning." Since its foundation, Koç University has encouraged the search for truth through research, criticism, and creativity. Cooperation with international

institutions, as well as lectures by internationally renowned academics and business leaders, also contribute to the quality of education at Koç University. The University has exchange programs with selected universities abroad. It is also involved in Erasmus programs.

The University is composed of the College of Arts and Sciences, the College of Administrative Sciences and Economics, the College of Engineering, the Law School, the School of Nursing, the Graduate School of Business, the Graduate School of Sciences & Engineering, the Graduate School of Social Sciences & Humanities, and the English Language Center. Graduates of the four-year undergraduate programs in History, Philosophy, Art History and Archeology, English Language and Comparative Literature, Sociology, Psychology, Economics, Business Administration, International Relations,

and Law are awarded BA degrees. Those in Chemical and Biological Engineering, Computer Engineering, Electrical and Electronics Engineering, Industrial Engineering, Mechanical Engineering, Mathematics, Physics, Chemistry, Molecular Biology and Genetics and Nursing receive BS degrees. The Graduate Schools offer 26 different programs with degrees in Ph.D, M.S., M.A., MBA and Executive MBA.

Koç University has an alumni body of 4002, with 2945 students from its undergraduate programs and 1057 from its graduate programs. The rate of employment within six months of graduation is almost 100%. Over 400 of the graduates of Koç University were placed to top graduate programs worldwide and its graduates who join the work force were sought after by the most desirable national and multinational companies in Turkey as well as abroad.



# Graduate Programs at Koç University

Quest for scientific knowledge and performing pioneering research requires high quality graduate education. With business world's and industry's growing interest in research,

development and innovation due to global competition and shortages of faculty members in universities, the demand for graduate students who have the necessary specialization and

academic preparation is rapidly increasing. Our graduate programs recognize this need and aim to provide the best education and research support to high quality students.

## 1. GRADUATE SCHOOL OF BUSINESS

### Masters Programs

MBA  
Finance  
Executive MBA

### Ph.D. Programs

Business

## 2. GRADUATE SCHOOL OF SCIENCES AND ENGINEERING

### Masters Programs

Chemical and Biological Engineering  
Computational Sciences and Engineering  
Electrical and Computer Engineering  
Industrial Engineering  
Materials Science and Engineering  
Mathematics  
Mechanical Engineering  
Physics

### Ph.D. Programs

Chemical and Biological Engineering  
Computational Sciences and Engineering  
Computer Engineering  
Electrical & Electronics Engineering  
Industrial Engineering and Operations Management  
Materials Science and Engineering  
Mathematics  
Mechanical Engineering  
Physics

## 3. GRADUATE SCHOOL OF SOCIAL SCIENCES AND HUMANITIES

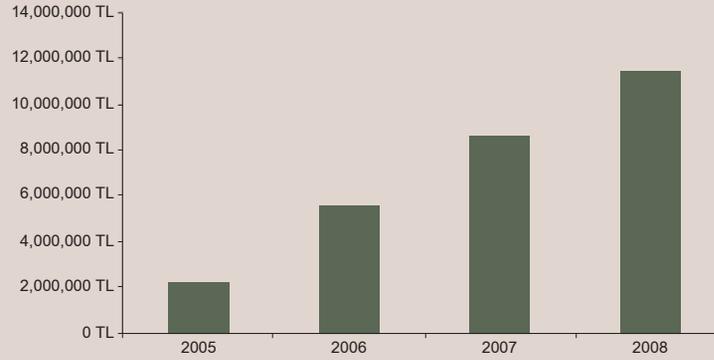
### Masters Programs

Anatolian Civilizations and Cultural Heritage Management  
Comparative Study in History and Society  
Economics  
International Relations  
Psychology

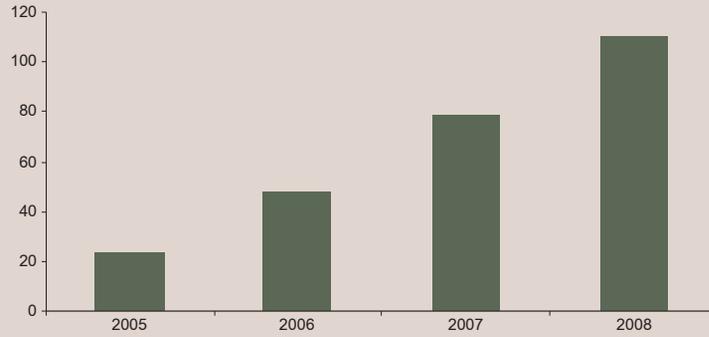


# Research Funding

Koç University's external research funding has shown a remarkable increase over the years as shown below.



109 research projects are funded externally by government, industry, USA and European Union. The increase in the number of funded projects over the years is shown below.



## Current Research Sponsors

- Vehbi Koç Foundation
- Arçelik
- Aygaz
- Ford Otosan
- Koç System
- OTOKAR
- TÜPRAŞ
- OSD (Automotive Industries Association)
- TÜBİTAK (Scientific and Technological Research Council of Turkey)
- TÜBA (Turkish Academy of Sciences)
- DPT (State Planning Organization, Turkey)
- IBM
- IBB (The Municipality of Istanbul)
- ASELSAN
- Open Society
- European Union
- Max Planck Society
- PME Foundation, Switzerland
- National Institute of Health, USA
- USIP: United States Institute of Peace
- Microvision, USA
- Microsoft, USA
- Wacker Chemie AG

# Research News

## European Union Project Office

Koç University launched the European Union Project Office and appointed Ms. Sevgi Ural as its director. EU Project Office will inform faculty on EU programs, open calls, funding mechanisms; will help with project preparation, writing and coordination, contract negotiations with European Commission, planning and managing the scientific activities, preparation of technical reports, coordination of communication with project partners and EU-Commission. Execution of legal and financial forms and preparation of financial reports will be done in cooperation with the Office of the Comptroller.

Ms. Sevgi Ural received her BA degree in Business Administration from the University of Miami and MA degree in International Affairs from the George Washington University. Before joining KU she was the General Coordinator at ARI Teknokent.

## Koç University Postdoctoral Fellowship Program

Starting with the Summer of 2008 Koç University will provide Postdoctoral Fellowships to support the scholarly development of all qualified candidates who are committed to academic careers. In this way, Koç University aims to contribute to the development of research faculty to help alleviate the faculty shortages in Turkish Universities. At the same time the program provides an opportunity to Koç University faculty to work with postdoctoral fellows in research areas of mutual interest.

Research excellence will be the major criterion during the evaluation of the proposed fellowship project and the candidate. The applicant must have a distinguished track record of research accomplishments in the fields of interest to the faculty at Koç University. Applications will be evaluated by a university-wide review committee.

The fellowship award is for one year beginning July 1, 2008. Fellowships may be renewed for an additional year. Maximum duration is two years. A list of available projects and further information about the program is provided at [www.ku.edu.tr](http://www.ku.edu.tr).

## KU Summer Research Program for Undergraduates

In the summer of 2008 Koç University is starting a new program for undergraduates. It is the “undergraduate” version of KU Summer Research Experience for High School Students which has been successfully running since 2004.

This program is for motivated undergraduates who want to improve their research skills and plan to attend graduate school. The program offers the undergraduates the opportunity to gain research experience that helps them decide if they want to pursue graduate education or professional research career. Students are exposed to a broad range of new concepts and research techniques which help to improve their independent thinking and creativity.

The duration of the program is at least seven weeks. Beginning and ending dates are flexible to accommodate the needs of the particular student and the research faculty.

Students choose from the research projects of KU faculty to match their areas of interest. They work closely with faculty mentors and their research groups that include graduate students and advanced high school students who participate in KU Summer Research Experience for High School Students. Further information is available at [www.ku.edu.tr](http://www.ku.edu.tr)







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