



LEARNING TO DESIGN FOR PRODUCTION: INDUSTRY AND ACADEMIA COLLABORATION

Mehmet Ali ALTIN^{1*}

¹Interior Design Department, Architecture and Design Faculty, Anadolu University, 26070, Eskisehir, Turkey
maaltin@anadolu.edu.tr

Received: 25.10.2016, Accepted: 12.12.2016

*Corresponding author

Abstract

Furniture design in interior design courses at Universities are often held in design studios or in theoretical classes. In theoretical classes the practical output of furniture production is ignored and it lacks of an important input from production. This situation is compensated by applied classes in wood workshops which are established with a limited variety of production techniques. As most of the industrial products furniture is made out of many components and materials. These are produced in industrial establishments by installation of required production techniques. Instead of producing a marketable product, in interior design courses the aim is to have an experience of furniture production due to that they do not have all possible production techniques installed in workshops.

In this paper, a joint project between academia, which is more close to design and industry, which is more close to production is discussed with a focus on benefits of this collaboration for both sides. Paper comprises an evaluation of a one term experience of interior design students in collaboration with laminated wood furniture factory.

Keywords: University Industry Collaboration, Furniture, Education

ÜRETİM İÇİN TASARIMI ÖĞRENMEK: ENDÜSTRİ VE AKADEMİ İŞBİRLİĞİ

Özet

Üniversitelerin iç mimarlık bölümlerinde, mobilya tasarımı dersleri çoğunlukla iç mimari proje dersleri içinde ele alınmakta ya da farklı teorik derslerde işlenmektedir. Teorik olarak ele alınan ancak çıktuları pratik uygulamalarla elde edilen mobilya tasarımı eğitimi pratik girdilerin göz ardı edilmiş olmasıyla eksik kalmaktadır. Bu durum iç mimarlık bölümlerinde kısıtlı imkânlarla kurulan ahşap atölyelerinde uygulamalı bir takım derslerle telafi edilmeye çalışılmaktadır. Birçok endüstri alanında olduğu gibi mobilya da, pek çok farklı malzeme ve bileşenin bir araya gelişi ve ihtiyaca uygun üretim yöntemlerinin sanayi kuruluşlarında teşekkül edilmesiyle vücut bulur. Sonucunda pazarlanabilir bir üründen ziyade tasarım ve üretim sürecinin deneyimlenmesini hedefleyen iç mimarlık bölümü mobilya atölyeleri endüstriyel üretim imkânlarının çoğundan yoksundur.

Bu çalışmada mobilyanın tasarım tarafına daha yakın olan akademi ile üretim konusuna daha hakim olan endüstrinin ortak bir projede birbirlerinden kazandıkları ortaya konulmuştur. Çalışma iç mimarlık öğrencilerinin, bir dönem boyunca ahşap laminasyon tekniğiyle üretim yapan bir endüstri kuruluşuyla yaptıkları çalışmaların değerlendirildiği sonuçları içermektedir.

Anahtar Kelimeler: Üniversite Sanayi İşbirliği, Mobilya, Eğitim

1 Introduction

Furniture design is an essential part of interior design education. The setup of furniture design classes is mostly affected by the needs of the interior design profession. Furniture is used in interior design in two ways: 1. as an important object which is part of a design setup and is chosen from ready-made alternatives in order to achieve the desired aura of a space. 2. As a custom made object which is produced by dedicated firms and installed as a unique object by guidance of the interior designer. These two approaches are basis of furniture design classes. First approach is taught in studio classes in which the major factor of design is to have a conceptual unity. The second approach is more different than those verbal or visual classes therefore furniture design classes are mostly held on an introduction to furniture design, materials and production methods. In Anadolu University, Interior Design Department has a wood workshop for visualizing these introductions and having hands-on experience on furniture production. Wood workshop has essential tools for timber based production and employs 2 craftsmen. Students design their own furniture and make them be produced in the workshop. Because the workshop allows

very primitive production, students who are interested in further production techniques, the next stage of the class does not provide a new technique. For demonstrating new techniques and widening up student's imagination on design for production a collaboration between university and industry has been realized.

1.1 University and Industry Collaboration

University-Industry Collaboration (UIC) is the sum of all activities of education, research and development and service which are combined methodologically and systematically. These activities are constructed on existing facilities of University (knowledge, staff, equipment...) and industry (experience, staff, financial resources...) for the benefit of both and the society. Benefits are more than the sum of the elements [1].

As seen from above explanation UIC is a mutual relationship which is better for motivation of both sides. This relationship is better explained by expectations of both sides.

With reference to Odabaşı et al. [2] For the university these expectations are:

1. Performing one of its primary missions by solving problems of the industry and by the way helping economy,
2. Supplying substantive contributions to the university by having this collaboration,
3. Extending industrial experience of university staff,
4. Academic publishing of outcomes of this collaboration,
5. Obtaining patents from suitable projects,
6. Having more support for internship from industry.
7. Developing student projects by the support of industry, by the way having students experience real life problems and deal with them on site.
8. Support from industry for organizing conferences and academic congress in universities, where new developments and problems are being discussed.

Universities have possibilities for industry:

1. R & D for industry,
2. Helping industry to develop technology instead of transferring, by the way supporting economy.
3. Aiding industry to develop their own standards.
4. Creating a persistent knowledge platform and saving it.
5. Employing students as half or full time researchers in research activities, by the way they will have R&D abilities.

Industry has expectations from this relationship:

1. Solving its problems rapidly,
2. Solving problems without employing high salary staff, by the way reducing costs,
3. Solving high tech problems without setting up high cost laboratories.
4. Making R&D without high costs.
5. Obtaining knowledge from universities for applying EU project.
6. Gaining support in order to obtain obligatory certificates for international rivalry.
7. Bearing in mind the needs and problems of industry for theoretical research.

Expectations and possibilities in the collaboration between university and industry does not always coincide. In most cases there are problems in starting and keeping the collaboration. These problems mostly occur for some reason. According to Othman et al. [3] these are important from two perspectives:

From industry perspective:

- The industry is unwilling to ensure financial contribution related with the subject, to the education programme.
- It has not got sensitivity about the necessity of education programme and a serious contribution will be ensured by means of the university.
- By interrogating the education programme which was formed by the universities, industry is inclined to think that perhaps they know all the solutions much more than them.

From university perspective:

- Educators cannot be sensible about the sensitivity of time limitations of the industry and developing the expert productive power,
- University cannot be aware of the real problems that the industry is faced with and for instance, limited with uninterested programme and imaginary world,

- Possibilities cannot be adequate to ensure the needs of the industry.

Above mentioned facts are free from size or profession of both partners. Some collaborations are demanding high tech solutions, which depend on special laboratories and highly qualified staff especially those in doctorate status. These collaborations need contracts which support partners by explaining duties and benefits of both. In order to support collaboration, governments encourage both partners by special promotions. Universities set up techno cities and collaboration offices which deal with the legal infrastructure of this collaboration. These kind of collaborations have higher risks and higher benefits which must be kept under strict control. Some other collaboration is done with small scale firms (<50 workers) and universities. In this case risks are more tolerable and benefits are modest. These kind of collaboration is more flexible, easy to start and easy to end.

According to Ankrah and AL-Tabbaa [4] there are 6 forms of collaborations:

1. Personal Informal Relationships,
2. Personal Formal Relationships,
3. Third Party
4. Formal Targeted Agreements,
5. Formal Non-Targeted Agreements,
6. Focused Structures.

Also according to Ankrah and Al-Tabbaa, Personal Informal Relationships is missing of formalization of the agreement, while in the remaining groups the relations are formalized. Ring and Van de Ven [5] put emphasis on the issue of formalizations importance; increasing formalization and monitoring of the relationship in a UIC could lead to conflict and distrust among parties.

For universities accessing the researching fund is the most dominating motive [4]. For this reason universities are likely to be in a vulnerable position because they have less power and control over the agreement.

1.2 Motivation

Interior design has two types of relation with furniture as mentioned before. While choosing furniture for an interior design project, interior designer has relation with mass produced products. Designers involve neither in design nor production of the furniture. They choose furniture from showrooms, shops or catalogues. At the other hand, while designing a unique furniture and making it be produced, designer involves in design and production of furniture. In this manner he/she starts a relation with the producer, negotiates with him on material choices and production details. These producers are usually small scale firms which do not have a mass production line. They produce one off products on order. These small scale furniture firms also produce their own designs and keep a portfolio of their own productions.

At Anadolu University-Interior Design Department, in 2015-2016 Spring Term, Furniture Design 2 Class has been held in collaboration with KYS Chairs. This paper discusses a UIC between 12 undergraduate students and a small scale furniture firm as a case study.

Partners:

KYS Chairs (Kenan Yeni Sandalyeleri) [4] is a well-known furniture factory in Eskişehir which is in production field since 1965. KYS mostly deals with laminated wood chairs and furniture and also produces order based one off productions in diverse types. KYS mentions their vision as "Always being innovative and distinctive". The owner Mr. Göksal Günaydın has

a graphic design origin and he believes in good design and innovation. The company has won 2012 Design Turkey Award with their "Wings" armchair.

Anadolu University-Interior Design Department [5] is distinctive from other departments on the weight of furniture design classes in total curriculum. It is also supported by a wood workshop for hands-on experience. Furniture design classes are held in 3 semesters in 3 groups. There are also other aiding classes as "furniture construction", "model making" and "toy making" all of which are held in the wood workshop in a hands-on manner.

In first furniture class students learn theoretical facts about furniture, furniture materials, furniture types and production technics. In the second class design course starts and students their own chairs and make them be produced in wood workshop. In the third class students are asked to design furniture in a concept which may include a set of furniture, a style of furniture or furniture through a special production method.

In this sense laminated wood bending method has been chosen to deal with for 2016. It was chosen for the fact that it is a new method that cannot be provided at department wood workshop and students are familiar to use wood as furniture material. Laminated wood bending was taught previously in model making classes in order to visualize 1/5 scaled models of existing chair designs. In order to achieve this, thin wood veneers are pressed in wooden moulds than they are trimmed and shaped to create a chair model. This method was also the starting point of the collaboration.

Before starting a collaboration there have been a few assumptions about possible future problems:

1. Laminated wood bending technique has its own machinery and materials which cannot be moved out of its original place that's why in order to work with this method, students need to be in that special place.
2. 14 weeks of course schedule and KYS's unpredictable schedule could not have been suited each other.
3. While students are working in a risky place for so long time there could have been some unpredicted accidents.
4. For such a long time to get in touch in an unusual environment, it could have been difficult for both sides to keep motivation.
5. For tutor it could have been difficult to control students in an unfamiliar place.
6. It could have been difficult for students to travel to factory which is comparably far and the travel could be risky.

Most of these problems are related to location of the firm and difficulties at that location. For this reason, ways to transfer most of the work to department's wood workshop and minimizing the student work at factory were researched. Class has been divided into three phases: 1. Research, 2. Design, 3. Production. In order to pass more time at University and less in factory, first and second phases decided to be held at University and the third phase was decided to be held at factory.

1.3 Setting up the Studio

Before setting up the studio there had been a conversation between the tutor and the firm owner. From this conversation, industry's expectations and University's expectations were clarified.

Industry expectations:

1. Finding new ideas for a new product or products.
2. Finding interns to be employed in firm.
3. Improving new production technics

4. To take place in possible publication with our firms name.
5. To get in more sophisticated collaborations after this one. (EU or TUBITAK projects.)

University expectations:

1. Students experience a production from start to end.
2. Students have individual relationships with industry to see the difference from education.
3. Students have opportunities for internship.
4. Support from industry for prototyping.
5. Support from industry for demonstration of production techniques.
6. Support from industry for materials be used or wasted during design phase.
7. Finding a new design which will be published and patented with the name of the University.
8. Starting a relationship with industry for future collaborations.

When everything has been decided between the firm and the University, a way to regulate this collaboration legally has been researched. ARINKOM (Anadolu University Technology Transfer Office) was called for help. They have provided two solutions which of both did not help to start this collaboration on time. First was to start a TUBITAK project which has a long calendar and was risky. The other was project based internship which was more suitable but cannot be held during the semester. Because there has been no alternative to sign the collaboration on paper, it is decided to construct it on confidence and friendship.

The studio is constructed on three main phases as mentioned before. To transfer most of the studio work to department's wood workshop, it is planned to hold design phase on 1/5 scaled laminated wood models. It was chosen for two reasons: 1. Students are familiar to this method. 2. It is so similar to the actual production. Because the actual production method is depending on modular pieces getting together to form a new design, students could have used this method without spending so much material. Also they might have used more familiar tools and techniques in comparison to build a 1/1 scaled production.

1.4 The Studio

Research

In the first phase of the studio, students are asked to research wood bending methods and wood lamination in literature and prepare a presentation. Students are worked in groups of three people. After presentation a discussion about wood bending and lamination has been done. The similarities between the methods in model making class has been mentioned.

In the third week of the course a trip to KYS factory has been organized. Students are guided by firm owner and they have watched the process of wood bending and other workshops as CNC cutting and trimming, upholstery, mould making, painting and finishing. KYS gave thin profiles of existing laminated parts. The idea was drawing them in 1/5 scale and using them to create wooden moulds for pressing veneers to create models.

In the next lesson making of a laminated wood model has been demonstrated to students and they are asked to create their own models out of drawn templates of KYS Chair's parts. Students made model molds out of pine timber. They have traced the template on timber and made the timber be cut on through those traces. They have filed the timber and sanded. After they have overlaid veneers one by one spreading glue on them. Then they have put the veneers and glue in between two

molds. Molds had to be kept untouched for 3 days to make them be hardened enough. (Fig. 1, 2.)

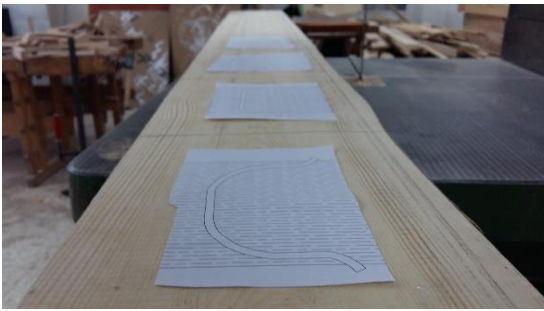


Figure 1. Templates



Figure 2. Making of the mould and the part

Design

The idea in working with models was to have nearly unlimited pieces for trials. There had been a slight problem to achieve this idea that there were too many different pieces and that's why there must have been many molds. Molds could be used several times but the time needed for drying was too much for having many pieces in a short time. During the visit to KYS Chairs factory a CNC machine was working on a piece. Factory owner and tutor had agreed on cutting the mold pieces precisely from MDF material to produce longer molds by attaching MDF pieces together linearly. With this operation, students could have experienced data transfer to computer aided manufacturing devices. Later on a misunderstanding has been realized that due to capabilities of CNC machine small pieces could not be cut. This misunderstanding had changed most of the plans. Students tried to produce as much pieces as they could but with limited number of molds the pieces could not be reproduced. Because of low amount of pieces' students have sliced them into small ones to try available possibilities. (Fig. 3.)



Figure 3. Slices

Students were not limited to a furniture type as chair, stool or table. They were just limited to use the same pieces that KYS Chairs use for their production line. It was also allowed to use other extra supporting material as metal profiles, glass or plastic.

Students had lots of trials with existing slices but to design in this manner was more difficult for them than expected. Pieces were too small to find proper construction methods. Small pieces were more difficult than bigger ones to hold together. It also had some advantages that students could take the pieces at home with them and study different alternatives at there but it also was not efficient enough than expected. Fig 4. Shows some of the trials with 1/5 pieces.



Figure 4. Trials with slices

Students had to find 2 main ideas: 1. a function for the furniture, 2. a producible form created out of existing parts.

Because students did not have enough pieces, they had to reproduce parts every week but after some time this procedure became an endless and droning work. Pieces were still not enough for trials like cutting and gluing. In order to share every type of piece to each they had to slice wider pieces into thinner ones which later affected their thought as all designs had to be from slices.

Due to the dropping motivation of class, students are asked to model their parts in computer and rearrange them not as strips but as planes. This approach was an accompanying technique to designing with scaled models. (Fig.5.)

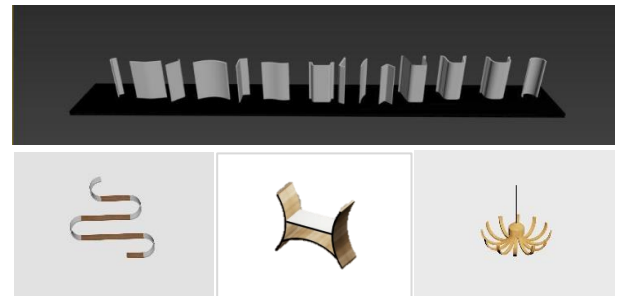


Figure 5. Computer models

KYS Chairs has granted 2 pieces from nearly every type of piece in their inventory for students to work on. These pieces has been transported to department's wood workshop. Students liked to work with them but because of the limited amount of each piece before trying something on actual piece students are asked to prove their form on computer or physical models. Most of the students did not find it comfortable. The time was passing the deadline was closing and most of the students did not have a substantial design proven on models. Students are advised to visit KYS Chair again individually to ask for help and improve their designs. At the end there were lots of 3D computer models which of most were not proven on physical models, students are asked to present what they have from the beginning to end. It was understood that most valuable ideas were hidden and not shown or forgotten in past. By the aid of the tutor, valuable ideas combined or improved and students

are allowed to work with actual pieces. Some of the students needed to change their design or have found totally different things. Construction techniques were the most effectual phenomenon that changed their design

Production

With their final designs they moved to KYS Chairs factory and made their prototypes be produced there. Some of the student works was not found valuable enough to be produced. They have proven their design on 1/5 scaled models.

At the end of the term students were to deliver their prototype and a detailed report explaining the whole process from beginning of the course to the end. Fig. 6. Shows some of the final prototypes. They also had to answer an online survey which is prepared for evaluation of the class.

2 Methodology

The collaboration has been evaluated through student reports, student surveys and the survey answered by KYS Chairs owner Mr. Göksal Günaydın.

Student surveys are constructed on a 5 grade likert scale. Student reports are evaluated to understand the positive and negative points of this collaboration. Also the survey for KYS Chairs owner was constructed on 5 grade likert scale. The findings are evaluated for finding if the expectations from this collaboration meet the results. Also the course process is evaluated to find in which parts of this collaboration people were contented or uncontented.



Figure 6

3 Findings and Evaluation

Survey questions are created especially for the visible problems encountered during the process: Questions and survey results are listed. 12 Students are asked:

1. "What did you learn in this course?". "Wood bending technique" and "making scaled models" have the highest grade of 5. "Communicating to the producer" and "designing for production" have 4.91.
2. "Which of the phases in course were more efficient?". "Designing in computer" has the highest grade of 4.91 and "visit to the factory" have 4.25. "Designing with scaled models" has the lowest grade of 2.33.
3. "Which was the most confusing thing in course?". "Designing with scaled physical models" has the highest grade of 4.5. "Dialogues with KYS Chairs" has the grade of 3.58.

4. "Which one could have been better for this course?". "Starting final production earlier" has the highest grade of 4.66. "Unlimited quantity of materials for hands-on experience" has the grade of 4.5. "If I could have more knowledge about using the production tools" has 4.4. "Juries during the course for developing our designs" has the lowest grade of 3.3.
5. "What was the problem while producing scaled models?". "Reproduction of moulds" has the highest grade of 4.6. "Obtaining precise moulds" has 4.25. "Reorganizing parts and not enough veneer and glue" have the grade of 4.16.
6. "Which one would have been more helpful while designing with scaled models?". "If the moulds were wider" has the highest grade. 4.83. "If the moulds were more in quantity" has 4.75. "If the moulds could have been prepared in CNC" has 4.66.
7. "What was the problem while designing with scaled models?". "It was difficult to work with existing tools in the workshop for tiny pieces" has the highest grade of 4.58. "It was difficult to organize very similar pieces" has 4.41. We had the pieces as tiny strips instead of their actual shape has 4.33.
8. "Which was more helpful while designing in computer?". "Possibility of trying may alternatives fast and simply" has the highest grade of 5. "Imagining various materials and putting them into design" has 4.3.
9. "What was the problem while designing with computer?". "It was difficult to imagine the physical properties of the design in computer" has the highest grade of 4.75. "Even designing in 3D it was not the same feeling of handing on" has 4.33.
10. "What was the problem in collaboration with KYS Chairs?". "It was difficult to work there because their own working schedule was too busy" has the highest grade of 4.75. It was far from school has 4.41.
11. "What is still unfinished in your design?". "I do not have enough knowledge of upholstery" has the highest grade of 3.5. "I do not have enough knowledge for wood bending technic" has the lowest grade of 2.16. The average grade over all the answers to this question is 2.96.
12. "What do you think about your design and product at the end?". "I can see my effort on the product" has the highest grade of 4.66. "I liked the product which I designed" has 4.33. "This product is mine" has 4.4. The lowest grade is 2.91 for "I think my product is finished".

From above mentioned, summarized results it can be seen that students think that they have learnt a lot from this class. They did not like designing with scaled models but they also know that this is because of the unavailable infrastructure. Students also think that collaboration with industry is a good activity to learn from but it is also difficult because it is not familiar. Students think that they could have done better designs if the schedule of the class was well organized and if there were more time for production. At the end students loved their product.

The questions and answers for KYS Chairs owner are shown in Table. 1,2,3,4 with their likert grades out of 5.

Table 1

Question	Likert grade out of 5
I was contented from this collaboration.	4
My expectations from this collaboration has been ensured.	4

Table 2

Question	Likert grade out of 5
What could have been the reason for your expectations be not ensured?	
The working schedule	4
The students were not motivated enough	5
The collaboration ruins our existing work.	2
The materials and budget was too much for this collaboration	2
The income from this collaboration was less than our expectations.	3
The time reserved for this collaboration was not enough	4

Table 3

Question	Likert grade out of 5
After the collaboration	
There are some designs that I liked from student works.	5
This collaboration opened gates for new ideas for putting in production.	4
These ideas are valuable to be used at my firm.	4
The budget and materials reserved for this collaboration was too much	3
With more materials and budget there could be better designs.	2
If students were working in factory for longer there could have been better designs.	5
The collaboration ruined my existing works in the factory.	3

Table 4

Question	Likert grade out of 5
For this collaboration what should have been done for possible future collaborations.	
A more organized collaboration could have been better.	5
Working with part in less variety but more quantity could have been better.	4
Working more at factory could have been better	4
Holding juries during the course could have been better.	3
More close relation of the tutor with the firm could have been better.	3
It could have been better to keep the collaboration on a legal contract.	4
The expenses should have been shared by the institution	3
It could have been better if students were transferred to the factory by institution.	4
If the students had more knowledge.	5

From answers to above questions, it shows that industry is very contented by this collaboration. The firm owner has found students less motivated and less knowledgeable than he expected. In fact, those students were the most hard working ones from previous class of Furniture Design 1. They had experienced in hands-on processes at wood workshop. Student's answers about busy schedule of the firm and firm owner's answers were contradicting. Because the production of prototypes was condensed in a very short time students went to the factory together, it may have made a vision of busy schedule. Both students and firm owner think that working in the factory more could have ensured better results.

For the firm owner nearly all the expectations were corresponded. They also employed one of the students from class for summer internship.

For the university, most of the expectations were corresponded. But there were problems due to the organization of the course. Because of these problems the course could not be kept under strict control. Pre-assumptions about factory conditions was not correct also the solutions (working with scaled models) for this situation was not efficient enough.

4 Conclusion

Most of the research in literature shows collaborations between University and industry on technology transfer and R&D works between bigger industries and high-tech laboratories of Universities. These collaborations are studied a lot before realization.

Most of the companies having contact with interior designers are small scaled companies which employs less than 50 workers. They usually do not have their own R&D departments and to employ designers is difficult. A collaboration with these companies will bring new approaches to their way of thinking.

In this case study, a spontaneous and fast pace collaboration has ended with lots of incomes and future expectations. The collaboration was standing on confidence and friendship. There was no formal contract between industry and university. Universities infrastructures as techno cities or technology transfer offices are too much complicated and time consuming for such a collaboration which needs to start fast, acted immediately. These collaborations at first do not bring patents or mass publish but there are lots of possibilities. Universities must organize infrastructure for these kind of collaborations because the industry side (for small scale companies) is not well organized in this sense.

5 Acknowledgement

This study was presented as an oral presentation at the II. International Furniture Congress, 13-15 October 2016, Muğla, Turkey.

6 References

- [1] C. Dura, "Üniversite Sanayi İşbirliği Üzerine Bir Deneme", Siyasal Bilgiler Dergisi, cilt 49, no. 3-4, pp. 101-117, 1994.
- [2] A. Odabaşı, Ş. Helvacıoğlu, M. İnsel ve İ. H. Helvacıoğlu, "Üniversite Sanayi İşbirliğinde Bir Model", Gemi ve Deniz Teknolojisi, no. 183, pp. 20-25, January 2010.
- [3] R. Othman ve O. A. F., "University and Industry Collaboration: towards a successful and sustainable partnership", Procedia- Social and Behavioral Sciences, no. 31, pp. 575-579, 2012.
- [4] S. Ankrah ve O. AL-Tabbaa, "Universities-industry collaboration: A systematic review", Scandinavian Journal of Management, vol 31, no. 3, pp. 341-408, 9 2015.
- [5] P. Ring and A. Van de Ven, «Developmental processes of cooperative interorganizational relationships,» Academy of Management Review, no. 19, pp. 90-118, 1994.
- [6] "KYS Chairs," Available: www.kyschairs.com/ [accessed: 11 08 2016].
- [7] "Anadolu Üniversitesi İç Mimarlık Bölümü", Available: <https://www.anadolu.edu.tr/akademik/fakulteler/197/ic-mimarlik-bolumu/dersler>. [Accessed: 11 08 2016].