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EFFECTS OF JOINT PRODUCTION ON PRODUCTION COSTS: BRICK FACTORY SAMPLE*

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ABSTRACT

Akio Morita, president of Sony emphasized the necessity of joint production with his remarks "No company is an island. In a world where companies are in need of each other should consider ways to work with other firms, if they want to compete in the global market." In the national and international markets, companies that are party to the competition have joint ventures under different names in order to enter different markets, gain cost advantage, share risk and create synergy. One of common types of joint ventures is joint production.

Joint production is the production of one or few production processes in an establishment set up in joint with the competitors in the sector in order to reduce production costs. Since competitors carry out one or a few production processes jointly, joint production provides more reduction in production costs in comparison to individualized production costs, and this cost-reducing advantage should have a positive effect on any establishments. Our paper is aimed at examining the feasibility of joint production in brick factories to cut down on production costs and its effect on production costs of Erbaa brick factories in particular. Production processes in brick factories take place in four stages: raw material preparation, pressing, drying and baking. Results of the interviews with factory managers and technical staff, it was found that they could use the advantage of joint production in the raw material preparation stage. For the research, the production costs of the brick factory with 300 tones of tillage capacity per day and the raw material preparation plant with the tillage capacity of 3200 tons per day which can be used by 15 brick factories at different capacity levels were examined. As a result of the research, it is determined that production cost is 6.95 TRY/ ton in case of raw material preparation in individualized factory and production cost is 4.51 TRY / ton in case of joint production.

Keywords: Joint Venture, Joint Production, Production Costs, Brick Plants.

JEL Codes: M40, M41.

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ORTAK ÜRETİMİN MALİYETLERE ETKİSİ TUĞLA FABRİKASI ÖRNEĞİ

ÖZ

Sony'nin başkanı Akio Morita "Hiçbir şirket bir ada değildir. Firmaların birbirine muhtaç olduğu bir dünyada, eğer global pazarda yarışmak istiyorlarsa her firma başka firmalar ile çalışmanın yollarını düşünmelidir" sözleriyle işletmelerin küresel rekabetle yarışabilmek için ortak girişimlerde bulunma gerekliliğini ifade etmektedir. Ulusal ve uluslarası piyasalarda rekabetin tarafı olan işletmeler farklı piyasalara girmek, maliyet avantajı elde etmek, riski paylaşmak, sinerji oluşturmak için farklı isimler altında ortak girişimlerde bulunmaktadırlar. İşletmelerin kullanacakları ortak girişim türlerinden biri de ortak üretimdir.

Ortak üretim; üretim işletmelerinin üretim maliyetlerini azaltmak için üretim süreçlerinden bir veya birkaçının sektördeki rakip işletmelerle kuracakları tesiste birlikte üretmeleridir. Ortak üretimle, sektördeki rakip işletmeler üretim sürecinden bir veya birkaç aşamayı ortak yaptıkları için üretim maliyetlerinin bireysel üretime göre daha düşük seviyede gerçekleşeceği beklenmektedir. Elde edilecek maliyet avantajı ortak üretimden yararlanan bütün işletmelere olumlu yönde etki edecektir. Araştırmamızın amacı tuğla fabrikalarında üretim maliyetlerinin düşürülmesi için ortak üretimin yapılabilirliği ve bunun üretim maliyetlerine etkisini Erbaa tuğla fabrikaları için tespit etmektir. Tuğla fabrikalarında üretim süreci hammadde hazırlama, presleme, kurutma ve pişirme olmak üzere dört aşamada gerçekleşmektedir. Fabrika yöneticileri ve teknik personellerle yapılan görüşmeler sonucunda hammadde hazırlama aşaması için ortak üretimin yapılabileceği tespit edilmiştir. Araştırma için günlük 300 ton toprak işleme kapasitesine sahip Doğan Tuğla fabrikasının hammadde hazırlama maliyet yerinin 2016 yılı maliyet verileri ile Erbaa bölgesinde üretim faaliyetinde bulunan farklı kapasitelere sahip 15 adet tuğla fabrikasının ortak kullanabileceği hammadde hazırlama tesisinin kurulması durumunda oluşabilecek üretim maliyetleri araştırılmıştır. Araştırmanın sonucunda Doğan Tuğla fabrikasının hammadde hazırlama aşamasında üretim maliyetinin 6,95 TL / Ton olduğu, ortak kullanılacak hammadde hazırlama tesisinde üretimin yapılması durumunda üretim maliyetinin 4,51TL / Ton olacağı tespit edilmiştir.

Anahtar Sözcükler: Ortak Girişim, Ortak Üretim, Üretim Maliyetleri, Tuğla Fabrikaları.

JEL Kodları: M40, M41.

1. INTRODUCTION

Businesses are established with the aim of making profit, providing service to the society and maintaining the business and continue their commercial lives. Businesses need to achieve their goals and maintain their commercial activities and gain cost advantages in order to be part of the intense competition in national and / or international markets (Trenchard and Dixon, 2003). In order to achieve a cost advantage, businesses need to reduce their production costs to a minimum without reducing the product quality standards (Apak et al., 2012). In order to reduce production costs without reducing quality standards, various cost reduction methods such as kaizen costing, target costing, total quality management, JIT have been developed and successful results have been obtained with the application of methods.

Increasing competition with globalization lead enterprises to be more efficient and effective (Chen et al., 2018; Kargın, 2013). In a globally competitive environment, enterprises have inadequate technology, financial resources, knowledge and skills to survive and achieve profitability they aim (Öztürk, 2017). Businesses can achieve more economic results by cooperating with other businesses instead of doing some activities on their own (Kargın, 2013). Businesses agree on joint production to develop competitiveness capabilities, to realize large-scale projects that cannot be undertaken by a single person or a single company, to reduce costs, to provide the necessary financial resources, to share the existing risks, to open up to new markets and to profit by the benefits of technology transfer (Baumgärtner et al., 2001; Jin et al., 2009; Öztürk, 2017).

It is seen that the joint production, which is a kind of a joint venture, is now used to obtain cost advantages and share the risks in many different sectors and regions from micro level enterprises to international level enterprises (Carey and Mitchell, 2018; Rounti et al., 2005). IBM, Siemens and Toshiba collaboration to develop a new memory chip, jointly working of General Motors and Hitachi to develop electronic components for cars (Killing, 1995; Rangan and Yoshino, 1996), Rover and Honda entering into foreign markets, and forming alliances for product and technology development (Kardam, 2003; Rinehart et al., 1997) are a few examples of joint production. The most recent example of joint production is Toyota and Mazda's decision to set up a factory for manufacturing electric vehicles with a US $ 1.6 billion joint investment (Tajitsu and Nussey, 2017).

In this study, the feasibility of joint production for brick factories in Erbaa region and its effects on production costs were examined. In the first part of the study, the concept of joint production and joint venture types were explained. In the second part, the brick sector and the brick production process were explained. In the third part, the purpose, method and scope of the application were explained. In this section, the estimated installation and production costs of the raw material preparation cost location of the Doğan brick factory, the cost of the raw material preparation cost to be made jointly with the production costs of 2016 were determined and the results obtained were analyzed.

1.1 Joint Production

Today, globalization causes major changes in the business world. In the new business environment created by globalization, enterprises must renew their strategies and organizational structures in order to be successful. In the market conditions where the only successful ones exist, enterprises have to be able to use their resources in an effective and efficient way and to produce maximum products with minimum resources or with the resources available (Demirdüğen and Küçük, 2014).

In this new business environment where national and international intense competition is taking place, one of the tools that enterprises use to be successful is a joint venture. A joint venture can be defined as an agreement made by two or more undertakings in order to achieve an economic goal together by carrying out a work that they have to otherwise fulfill separately (Karakeçili, 1997). This partnership, considered a strategic option for many undertakings, has taken its place among the indispensable instruments of the business world. This type of partnership gives great advantages to many undertakings in entering new investment areas, overcoming technical, economic and legal obstacles, undertaking high cost investments and risk sharing (Kayıhan, 2003).

Joint ventures between businesses are often referred to as “strategic alliances” in the literatüre (Elmuti and Kathawala, 2001). The emphasis is on the parties' orientation towards strategic purpose (Hewitt et al., 2016). Strategic alliances can be explained in terms of voluntary agreements that are formed for various purposes, including exchange, sharing and co-development of products, technologies and services between enterprises (Gulati, 1998).

Firms work together to achieve competitive advantage in R & D, joint procurement, joint marketing and joint production (Das and Teng, 2001). Joint ventures that can be performed by enterprises are shown in Figure 1.

As seen in Figure 1, a joint venture provides rival and non-rival firms with advantages of service procurement, supply, R & D, marketing and production.

The main undertakings can combine their identical activities through the joint venture, thus reducing their costs (Kabiraj and Sengupta, 2018; O’Dwyer and Gilmore, 2018) and gaining synergies (Chen et al., 2015). Especially in sectors with high research and development costs, undertakings' carrying out their activities together rather than individually can lead to more effective results (Kayıhan, 2003).

Joint production, a kind of joint venture, can be defined as "the joint production of one or more production processes with the rival firms in the sector to reduce the production costs". The lower production costs will be achieved through a joint production strategy where rival firms carry out one or more stages of production process jointly and this cost advantage will have a positive effect on all enterprises.

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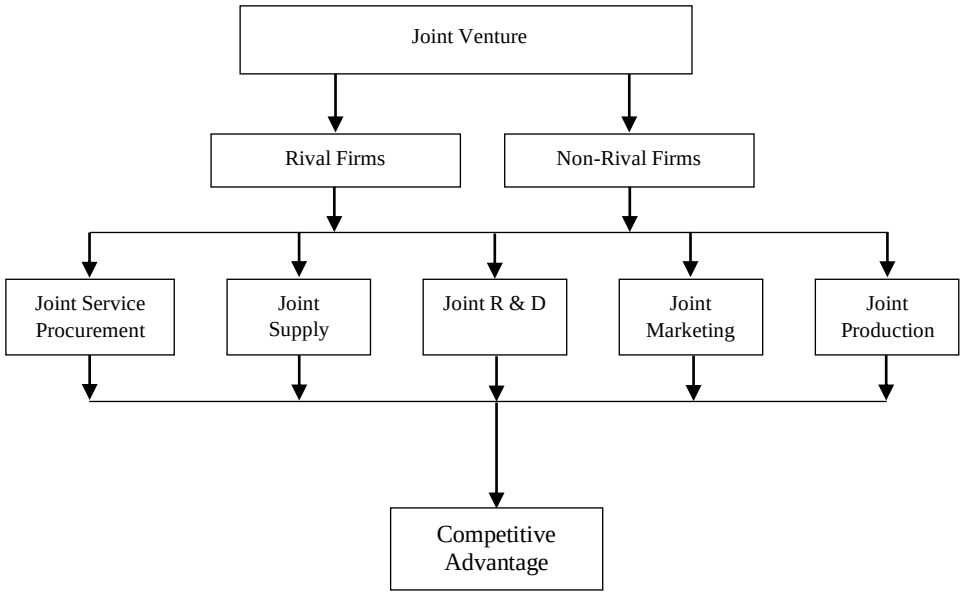

Figure 1: Joint Venture Models

1.2 Literature Review

There are national and international publications on joint production or coproduction in the literature. However, it has been observed that studies on the effect of joint on costs in production enterprises are lacking. Some of the studies on the subject are as follows;

Margarita Išoraitė (2009) introduced its strategic partnership and strategic partnership types, and with the approach that Toshiba can not control any technology on its own, it is a partner in technology development with its competitors such as Apple, Ericsson, GE, IBM, Microsoft, Motorola, Samsung, Siemens. He explained that they had made a strategic partnership in production and Toshiba was one of the leading companies in the sector (Išoraitė, 2009).

Tekin, Ömürbek and Bülbül (2005) conducted a survey with 131 companies operating in the sector, in order to determine what kinds of collaborations the companies operating in the automotive industry cooperate with, for what purposes they entered into technological cooperation and the level of achieving these goals. As a result of the research, they determined that the highest level of licensing agreements, joint venture, special agreements with suppliers are made as a technological cooperation, and the highest level of competitiveness and joint research are among the purposes of technological cooperation (Tekin et al., 2005).

Rounti, Mavridoglou, and Kyriazopoulos (2005) examined the capabilities of 228 medium-sized companies operating in the service, production and retail industries and how strategic alliances can help them in this regard. As a result of the research, they concluded that the formation of strategic alliances is an important tool for maintaining competitive advantage, and it is effective in saving costs, increasing quality, reaching technology and decreasing production costs (Rounti et al., 2005).

Yang and Xu researched joint production in the service industry and emphasized that synergies will occur between service providers and service users when acting together with customers and employees in creating the service (Yang and Xu, 2012).

Boyle, Clarke and Burns (2002) explained the history of joint production and how to create it with individuals, businesses, and institutions around the enterprise (Boyle et al., 2006).

Etgar (2008) examined the realization of co-production with the participation of consumers and determined the stages that the consumers to participate in co-production should pass, the emergence of conditions, the development of dominant logic and motivation motives, the evaluation of costs, cost-benefit analysis, activation and evaluation (Etgar, 2008).

Dedeoğlu (2015) examined the modern marketing approach from a discursive point of view to producers, consumers and consumption and examined the common production and common design approaches that started to shape the consumer culture literature (Dedeoğlu, 2015).

Arıca and Kozak (2018) conducted research in travel agencies to determine the effect of customers' participation in production on perceived service outcomes. The data of the research were collected through the survey technique from the local tourists who bought a cultural tour through the participation of the production from travel agencies and visited Istanbul, and found that the participation behavior of the customers directly and indirectly affected the perceived service outputs. They concluded that the direct impact of customers' engagement in production on perceived tourist service quality and perceived tourist value is positive (Arıca and Kozak, 2018).

Dilber (2004) examined the joint venture using the strategy of multinational corporations and concluding with the reasons for using the survey method created 38 joint venture manager in Turkey (Dilber, 2004).

Akkaya and Erdoğan (2019) emphasized how to work together with internal and external stakeholders and how to produce joint production in order to produce service in the public sphere (Akkaya and Erdoğan, 2019).

2. BRICK SECTOR

Brick and tile industry is one of the most important sub-sectors of the construction sector (Sevsay et al., 2013). The brick and tile industry is a sub-branch of the clay and cement industry ("Brick and Tile Industry Information," 2018). In the sectors whose main input is clay, productions are manufactured by shaping clay (Sevsay et al., 2013). The brick, which was the first building material in history, has been one of the basic building blocks of the construction sector since its production (Zhang et al., 2018).

China, Germany, Belgium, Algeria, Spain, India have a significant share in the production and export of brick. Depending on the conditions of supply of raw materials brick factory in Turkey seems to have been scattered all over the country (DPT, 2008). Provinces such as Tekirdağ, Turgutlu, Salihli, Afyon, Çorum, Boyabat, Erbaa, Osmancık, Avanos have an important role in the production of bricks in our country (Temel, 2017).

Brick production plants employ a stage production system. The brick production is formed through the interconnected stages. The processes and machines used in each stage change (Ertaş and Temel, 2018). The production flow in brick plants is shown in Figure 2;

As seen in Figure 2, the brick production starts with soil extraction and ends in the factory. In the factories, the stages of production are as follows; raw material preparation, shaping (pressing), drying and baking.

It was stated by the sector representatives that joint production could be done for the extraction of raw materials and preparation of raw materials in the production of bricks. Since the brick factories in Erbaa make soil extraction collectively, the cost of producing raw materials for the preparation stage was examined.

During the preparation of the raw material, a series of preliminary preparations are made to ensure that the soil used in the brick production has the appropriate properties both in size and in composition. In this stage, the soil which is the raw material of production is processed in various machines such as crusher, stone separator, crushing mills and mixer (Temel, 2017) to gain workability and homogeneous and to gain plasticity and cohesion properties (Şişman et al., 2006).

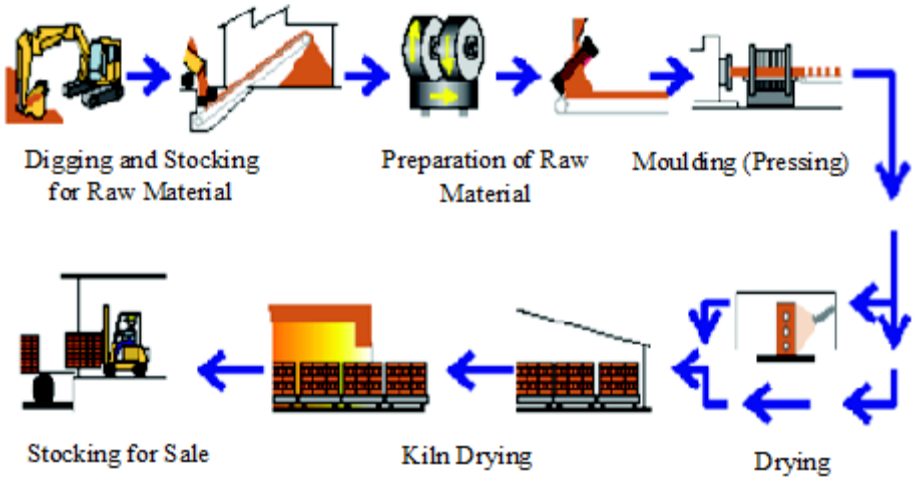

Figure 2: Brick Production Process (The Brick Industry Association, 2006)

3. RESEARCH APPLICATION

3.1. Objective

It is seen that joint venture culture in our country is not developed when compared to the developed countries. In today's business world where there is intense competition, businesses need to gain cost advantage in order to be competitive. This study was carried out to determine the effects of the joint production on the production costs in the brick factories in Erbaa region. The aim of the study is to determine the production cost during raw material preparation stage in Doğan Brick Factory by comparing it to that of raw material preparation stage in the plant planned to be used jointly.

3.2. Materials and Methods

The method of the study is observation and interview. In order to understand the production processes and determine the costs, data were obtained by interviewing the primary sources and observing the production processes.

3.3. Scope of the Study

Brick factories located in Erbaa district of Tokat province in TR 83 region were inspected. For the research, 2016 production cost data of the Dogan Brick factory and as the data of joint productions of raw material preparation, data of the plants manufacturing machinery for the brick factories in Çorum Organized Industry were used.

3.4. The Factory in Question

Dogan Brick Factory was established in 1987 as a limited company. The factory is founded on an area of 40000 m^2. 100000 pieces of bricks are produced daily in the factory by processing 300 tons of soil. There are 120

workers in the factory. The Hoffman type oven and coal is used for baking brick (*Doğan Brick*, 2017).

3.5. Production Flow of Dogan Brick Factory

The production flow of the Dogan Brick Factory is shown in Figure 3. Figure 3 shows the production flow of the Dogan Brick Factory. Doğan Brick Factory and all the brick factories operating in the region dig soil from the quarry to be used in production and transport it to the factory stock areas with trucks. The raw material preparation, which is the first stage of the soil production process, is processed at the production site. Semi-finished raw bricks are obtained after shaped in the pressing stage. Semi-finished bricks passing through the drying and baking stages complete the production process.

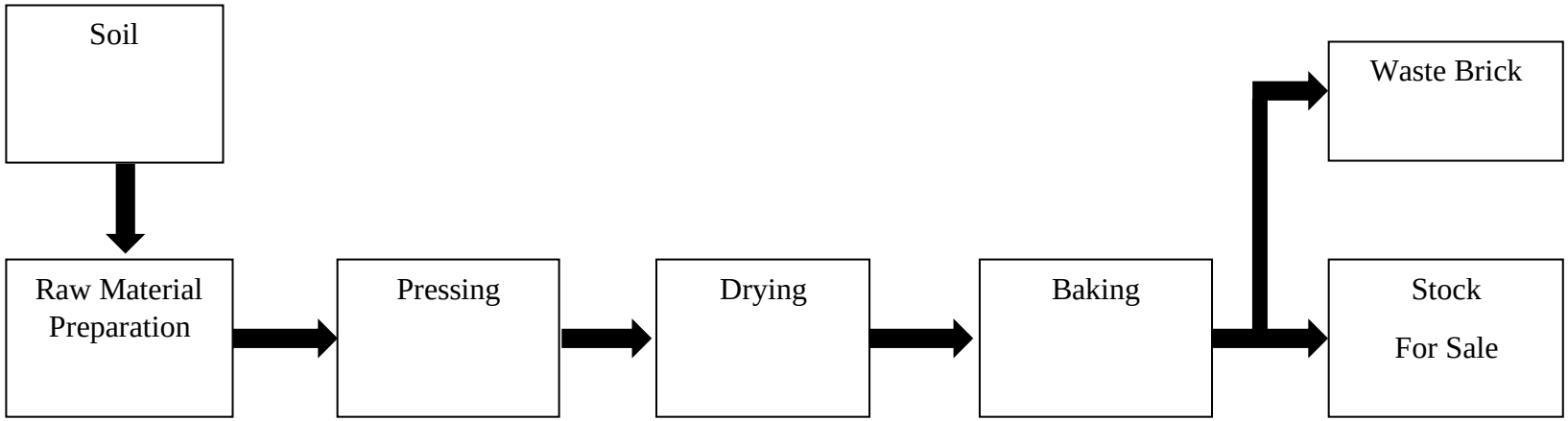

Figure 3: The production flow of the Dogan Brick Factory (Ertaş and Temel, 2018)

3.6. PRODUCTION COSTS OF DOGAN BRICK FACTORY

When examining the production costs, only the production costs in the raw material preparation stage were examined. The production cost in the raw material preparation stage was determined based on the criteria as follows:

3.6.1. Direct Material and Material Cost

The direct material and material of the brick factories is clay soil. For the year 2016, the tonnage cost of soil was 1.80 TL. For the year 2016, data of direct material and material cost used in production are shown in Table 1.

Table 1: Direct Material and Material Cost of Dogan Brick Factory

Soil Processed (Ton)	**Cost (₺ /Ton)**	**Total Cost (₺)**
102400	1.80	184320

As shown in Table 1, the Dogan Brick Factory used 102400 tons of soil in production in 2016 and generated a total cost of 184320 TL for direct material and material.

3.6.2. Direct Labour Cost

Digger operator, machinist and cleaner work as direct labor during the raw material preparation stage. According to 2016 data, costs for direct labor are shown in Table 2.

Table 2: Direct labor cost of Dogan Brick Factory

	Number of Workers	**Number of Months Worked**	**Total Cost of Direct Labour (₺)**
Digger Operator	1	12	29580
Machinist	1	11	27907
Cleaner	1	11	20207
Total			**77694**

As shown in Table 2, there are a total of 3 workers as digger operator, machinist and cleaner at the raw material preparation facility of Doğan Brick Factory, generating a total cost of direct labour of 77694 TL.

3.6.3. General Productions Costs

The general production costs of the Dogan Brick Factory during the raw material preparation are the costs of indirect material, indirect labor, energy

(electricity), maintenance and fuel (diesel). The costs for 2016 are as follows;

3.6.3.1. Indirect Material Costs

In the raw material preparation stage, materials used in the production process such as roller, bolt, belt, work glove, machine oil and cleaning materials are indirect materials. For the year 2016, according to accounting records, a total cost of 27500 TL indirect materials were used in raw material preparation stage.

3.6.3.2. Indirect Labour Costs

Maintenance workers and head-workers are indirect labor. For the year 2016, the indirect labor cost was distributed considering the labor time. Table 3 shows the indirect labor cost that belongs to the raw material preparation production.

Table 3: Dogan Brick Factory Indirect Labor Cost

	Raw Material Preparation (₺)
Headworker	17328
Maintanence	27256
Total	44584

As seen in Table 3, indirect labour during raw material preparation stage cost 44548.

3.6.3.3. Energy (Electricity) Cost

In order to make the soil ready for production in the raw material preparation phase, different types of machines are used. The cost of electricity varies according to the time and working hours of the machines. There is a separate electric clock for machines in the production site of the Dogan Brick Factory. Due to this feature, the Dogan Brick Factory was preferred for this study. The total amount of electricity bill for raw material preparation was 148924 TL in 2016.

3.6.3.4. Maintenance and Repair Cost

Routine maintenance of the machines used in the production site of raw material preparation is carried out. In 2016, the maintenance and repair costs for the machines used in the raw material preparation production site were determined. Data on maintenance and repair costs of each machine are separately shown in Table 4.

As seen in Table 4, it was determined that the maintenance and repair cost of the machines used in the raw material preparation by taking into consideration the parts that were replaced in 2016 was found to be 109660 TL.

3.6.3.5. Fuel (Diesel) Cost

Fuel cost occurs during blending of the soil and its transportation to the production site. In 2016, it was determined that the cost of fuel used to blend and load the raw material at the production site was 118780 TL.

3.6.3.6. Depreciation

Since the machinery in the raw material preparation stage of the brick factory did not complete its cycle and tracked with book value, the depreciation could not be determined.

3.7. COST OF JOINT RAW MATERIAL PREPARATION FACILITY

The joint raw material preparation facility is the facility that will make the soil ready for production in an amount that will meet the needs of the brick factories operating in the Erbaa region. Thanks to this facility, the brick factories in Erbaa will not produce raw materials individually in the production process; instead, it will start processing the ready-to-use material from raw material preparation facility. This facility is not yet established. As a result of the interviews conducted with the technical staff of the factories producing machinery for brick and tile factories in Çorum Organized Industrial Area and with brick factory owners in Erbaa, the establishment and operating expenses of this joint facility were determined.

Table 4: Maintenance and Repair Cost of Dogan Brick Factory

Type of Machine	**Parts Replaced**	**Unit Cost (₺)**	**Amount of Replaced Parts**	**Replacement Period**	**Yearly Cost(₺)**
Box Feeder	Box Feeder Wheel	66	40	1 year	2640
	Box Feeder Crawler	195	20	1 year	3900
	Box Feeder shaft	108	20	1 year	2160
Crusher	Blade	205	4	6 months	1640
Stone Separator	Separator Roller Mill	6500	1	2 years	3250
	Grooving	450	1	1 year	450
Roller	Roller Roller Mill	10500	2	18 months	14000
	Roller Grinding Mill	23	100	1 year	2300
	Roller Blade	11	150	1 year	1650
Mixer	Auger	7250	1	3 months	29000
	Mixing Liner	1320	1	6 months	2640
Conveyor belt	Barrel			1 year	1250
	Belt	170	10	1 year	1700
Digger				1 year	18080
External Maintenance Services				1 year	25000
Total					**109660**

3.7.1. Work-Flow of Joint Raw Material Preparation Facility

The production flow of the joint raw material preparation facility is shown in Figure 4 and Figure 5.

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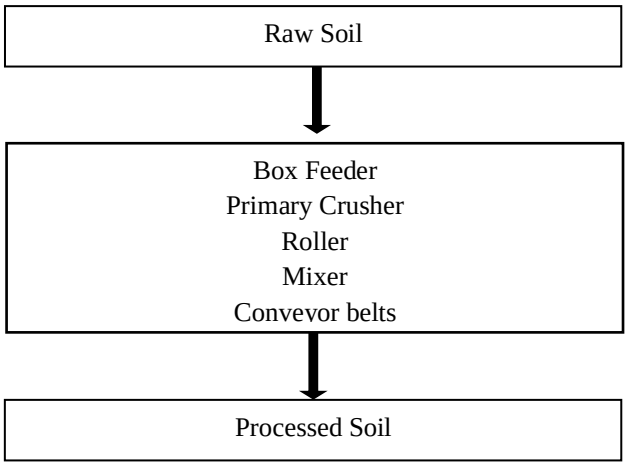

Figure 4: Work-Flow of Joint Raw Material Preparation Facility

Figure 4 shows the production flow of the common raw material preparation plant. The raw soil from the quarry gets ready to use after a series of processes in primary crusher, rollers and mixers respectively. Figure 5 shows the transportation of the processed soil produced in the raw material preparation facility to the factories. Today, the brick factories move the raw soil from the quarry to their factories and each factory prepares the raw soil separately.

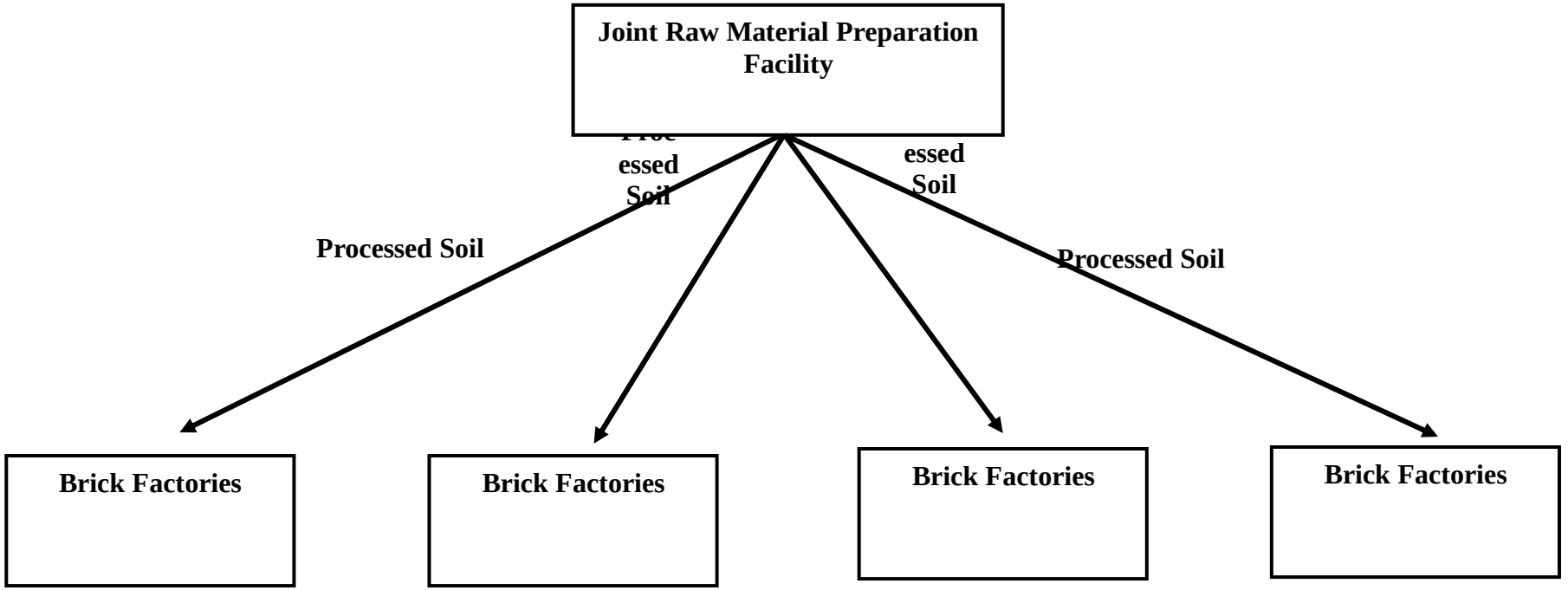

Figure 5: Supply of Raw Material after Joint Raw Material Preparation

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3.7.1. Start-up Cost

The types and cost data of the machines to be used in the joint raw material preparation facility were obtained as a result of the interviews conducted with the factories in Çorum Organized Industry manufacturing machinery for the brick and tile factories. The joint raw material preparation facility is required to be capable of processing 3200 tonnes of soil a day at 400 tonnes per hour. In order not to stop the production flow due to machine malfunctions, it is required that the facility be capable of producing over two lines with a capacity to process 200 tons of soil per hour. The cost of installation of the specified raw material preparation facility is shown in Table 5.

Table 5: Installation Cost of Common Raw Material Preparation Facility

Type of Machine	**Unit**	**Capacity (Ton /Hour)**	**Cost (₺)**
Silo Box Feeder	2	400	1450000
Conveyor Belt 150	8	400	
Single Rotor Crawler Primary Crusher	2	400	
Special Type Crusher Roller	2	400	
Mixer	2	400	

As shown in Table 5, the machine raw materials were created for two lines as the two raw materials preparation facilities were to be installed. The total installation cost of the two lines was determined to be 1450000 TL.

3.7.2. Operating Cost

The production costs that will occur when the raw material preparation facility is in operation are collected under the name of operating costs. The operating cost will consist of direct materials and materials, direct labor and overall production costs (Temel and Ertaş, 2017: 13).

3.7.2.1. Direct Material and Material Cost

The cost of the soil to the joint raw material processing facility would be 1.80 TL as it was in the brick plants. The joint raw material preparation facility would also supply soil from the same source as the brick factory. The amount of soil to be used by 15 brick factories on annual basis was calculated as 960000 tons. According to 2016 cost figures, the direct material and material cost of the joint raw material preparation facility is shown in Table 6.

Table 6: Direct Material Cost of Joint Raw Material Preparation Facility

Amount of Soil (Tone)	**Cost for per Unit (₺ / Ton)**	**Overall Cost (₺)**
960000	1.80	1728000

As seen in Table 6, for the 960000 tons of soil to be used by joint material preparation facility in production, the total cost was 1728000 TL for direct material and material according to the 2016 cost figures.

3.7.2.2. Direct Labor Cost

Direct labor in the joint raw material preparation facility included machinist, cleaner, bucket operator, truck driver. The facility was planned to operate for 8 months depending on seasonal conditions. Salaries were planned to be paid for 11 months despite the fact that workers were to be employed for 8 months. The types, amount and estimated costs according to 2016 minimum wage data were shown in Table 7.

Table 7: Direct Labor Cost of Joint Raw Material Preparation Facility

	Amount	**Gross Wage (₺)**	**Bounty (₺)**	**Employer's Share (₺)**	**Annual Labour Cost (₺)**	**Annual Cost of Employer's Share (₺)**	**Total Cost (₺)**
Machinist	2	1750	500	201	49500	4422	53922
Cleaner	2	1647		190	36234	4180	40414
Bucket Operator	2	1750	750	201	55000	4422	59422
Truck Driver	4	1750	500	201	99000	8844	107844
Total	**10**				**239734**	**21868**	**261602**

As shown in Table 7, two machinists, cleaners, bucket operators and four truck drivers were to be employed and given salary for 11 months and the total cost would be 261602 TL.

3.7.2.3. Overall Production Cost

Indirect material, indirect labor, energy (electricity), maintenance, fuel (diesel) and depreciation costs account for the joint raw material preparation facility as overall production cost.

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3.7.2.3.1. Indirect Material Cost

Operating expenses are indirect materials such as machine oil, bolts, bearings, cleaning materials, working clothes and safety materials. The annual cost of indirect materials was estimated to be 90000 TL.

3.7.2.3.2. Indirect Labor Cost

In the joint raw material preparation facility, maintenance workers and foreman (headworker) were to be employed as indirect labor. For the indirect workers, the estimated cost according to 2016 minimum wage data was shown in Table 8.

Table 8: Indirect Labor Cost of Joint Raw Material Preparation Facility

	Amount	**Gross Expense (₺)**	**Bounty (₺)**	**Employer's Share (₺)**	**Annual Labor Cost (₺)**	**Annual Employer's Share (₺)**	**Total Cost (₺)**
Maintanance Repair	2	1750	500	201	49500	4422	53922
Headworker	1	2000	750	230	30250	2530	32780
Total	**3**				**79750**	**6952**	**86702**

As seen in Table 8, it is estimated that two maintenance and repair workers and one headworker were to work in the joint raw material preparation facility and a cost of 86702 TL would occur.

3.7.2.3.3. Energy (Electricity) Cost

The data regarding the types of machines and how much energy they use were obtained from the producers. Kilo-watt hour information is shown in Table 9 according to the types of machines.

Table 9: Kwh Information of Joint Raw Material Preparation Plant

Type	**Unit**	**Engine Power (Kwh)**	**Daily Usage (Hours)**	**Monthly Usage (Days)**	**Annual Usage (Month)**	**Annual Use of Kwh**
Box Feeder	2	11	10	30	8	52800
Belt	2	4	10	30	8	19200
Primary Crusher	2	250	10	30	8	1200 000
Belt	2	4	10	30	8	19200
Roller	2	300	10	30	8	1440000
Belt	2	4	10	30	8	19200
Mixer	2	75	10	30	8	360000
Total						**3110400**

As can be seen in Table 9, Kwh amount, which would be consumed annually by machines used in common raw material preparation facility, was calculated by taking into account the working times of the machines and the electric motors. The amount of Kwh spent by the machines would vary according to the current to be drawn by the electric motors. As a result of the interviews with the authorities, it was determined that the electric motors would draw 80% current. The energy (electricity) expenses that are expected to cost according to 2016 figures were shown in Table 10.

Table 10: Energy (Electricity) Cost of Joint Raw Material Preparation Facility

Type	**Annual Use of Kwh**	**According To The Drawn Current (Kwh)**	**Cost Per Kwh (₺)**	**Total Cost (₺)**
Box Feeder	52800	42240	0.33	11405
Belt	19200	15360	0.33	4147
Primary Crusher	1200000	960000	0.33	259200
Belt	19200	15360	0.33	4147
Roller	1440000	1152000	0.33	311040
Belt	19200	15360	0.33	4147
Mixer	360000	288000	0.33	77760
Total	**3110400**	**2488320**		**821146**

As seen in Table 10, the machines in the facility consumes 3111400 Kwh electricity and it will be 2488320 Kwh according to the current to be drawn by the machines. For 2016, the total electricity expense was estimated to be 821146 TL (electricity), costing 0.33 TL per Kwh.

3.7.2.3.4. Maintenance Repair Cost

Routine maintenance and repair costs occur depending on the operation of the machines used in production. The annual maintenance cost data of the machines were obtained from the factories manufacturing machinery. According to 2016 data, the annual maintenance and repair costs of the machines were shown in Table 11.

Table 11: Cost of Maintenance Repair of Joint Raw Material Preparation Plant

Machine	**Spare Parts**	**Unit Cost (₺)**	**Replacement Amount**	**Annual Cost (₺)**
Box Feeder	Box Feeder Wheel	85	60	5100
	Box Feeder Roller	275	30	8250
	Box Feeder Shaft	230	30	6900
Primary Crusher	Crushing Blade	390	24	9360
Roller	Roller Mill	30000	2	60000
	Roller Grinding Mill	45	150	6750
	Roller Blade	18	150	2700
Mixer	Auger	13500	4	54000
	Mixing Liner	3200	2	6400
Conveyor Belt	Barrel			10000
	Belt			5000
1. Line Total Cost				**174460**

As shown in Table 11, maintenance costs of TL 174460 were incurred for the single line and the joint facility was planned to have two lines. The cost shown in the table was the cost for a single line. Considering the second line, the total maintenance and repair cost is estimated to be 348920 TL.

3.7.2.3.5. Fuel (Diesel) Cost

In the joint raw material preparation facility, trucks are used to transport the soil from quarry to kiln and a loder will be used for loading the processed soil to the trucks. The factory officials informed that there will be a fuel cost of 85 cents per tonne for the transportation and loading of the soil. The cost of fuel (fuel oil) to be generated according to the amount of soil to be processed annually in the raw material preparation facility is shown in Table 12.

Table 12: Fuel (Diesel) Cost of Joint Raw Material Preparation Facility

Type of Expense	**Unit Cost (₺ / Ton)**	**Annual Amount to Transport (Ton)**	**Annual Cost (₺)**
Fuel Cost of Loading and Transportation	0.85	960000	816000

As seen in Table 12, it is estimated that 960000 tons of soil will be transported from the quarry to the plant and then to the factories after the processing.

3.7.2.3.6. Depreciation Cost

For the raw material preparation facility, depreciation is to be allocated for the machines to be used in production. The depreciation rate to be used in the depreciation calculation shall be calculated by considering the economic lives of the tangible assets. From the depreciation life table for the depreciation rate ("depreciation rate," 2018), it is determined that the economic life of the machines in the raw material preparation section of the brick factories is 8 years. The amount of depreciation calculated for the facility to be used in joint is shown in Table 13.

Table 13: Depreciation Cost of Joint Raw Material Preparation Plant

Machine	**Book Value (₺)**	**Economic Life (Year)**	**Depreciation Cost (₺)**
Box Feeder	1450000	8	181250
Primary Crusher			
Roller			
Stone Separator			
Conveyor Belt			

As shown in Table 13, the average economic life of the machinery of the raw material preparation facility is 8 years and the depreciation amount to be allocated according to the normal depreciation method is 181250 TL.

3.8. Interpretation and Analysis

In our study, cost of the raw material preparation facility with a daily processing capacity of 3200 tons of soil processing capacity to be jointly used by 15 brick factories was calculated according to 2016 cost figures of Dogan Brick Factory which produces 100000 pieces of bricks per day with a production capacity of 300 tons of soil. Total and unit costs were determined. The cost data obtained as a result of the calculations are shown in Table 14.

Table 14: Comparison of Costs

	Brick Factory X	**Joint Facility**
Direct Material and Material Cost	184320	1728000
Direct Labor Cost	77694	261602
Overall Production Cost	449448	2344018
Indirect Material	27500	90000
Indirect Labour	44584	86702
Energy (Electricity)	148924	821146
Maintenance and Repair	109660	348920
Fuel (Diesel)	118780	816000
Depreciation		181250
Total Cost (₺)	**711462**	**4333620**
Annual Production Quantity(Ton)	**102400**	**960000**
Unit Cost (₺ / Ton)	**6.95**	**4.51**

As seen in Table 14, Dogan Brick Factory processed 102400 tons of soil at the raw material preparation site in 2016 and had a production cost of 711462 TL. The cost per ton of raw material processing was 6.95 TL / Tons (711462 / 102400). If the raw material is prepared at the raw material preparation facility, 960.000 tons of soil will be processed and the production cost will be 4333620 TL and the cost of the joint production will be 4.51 TL / Ton (4333620 / 960000).

As a result of the study, it was concluded that the joint preparation of raw materials is advantageous compared to individual production. When we calculate the advantage of joint preparation instead of doing this separately,

it is expected based on the data of Dogan Brick Factory that it will be TL 249856 [(6.95-4.51) 2.44 TL * 102400 Ton / Year].

4. CONCLUSION

In the global competitive environment, they make joint ventures with competitors or non-competitors to reduce production costs, increase profitability, share investment risk and achieve synergy without losing economic and legal independence of enterprises. One type of joint venture is joint production. Joint production is the production of one or more of the production processes together with the competing enterprises in the sector in order to reduce production costs.

In this study, the applicability of joint production in brick factories and its effect on costs were investigated. The research was carried out for brick factories in Erbaa region and costs were obtained according to 2016 figures. As a result of the interviews with factory managers, it was determined that joint production for brick factories can be done for raw material preparation stage. As a result of the study, it was determined that the unit production cost was 6.95 TL / ton when the raw material preparation cost of the Doğan brick factory was produced at the site. In case of joint production, it is concluded that the cost advantage will be 249.856 TL for the Dogan Brick Factory, which has a daily production capacity of 100,000 bricks.

The cost advantage of the plants will vary depending on the unit production cost at the raw material preparation stage and the amount of soil to be processed.

It was determined that the cost of production of the joint raw material processing would be lower than the individual production factory. Although it is known that it will provide cost advantage to the firms, it is not employed in our country because joint production culture is not yet developed. In addition, capital deficiencies of enterprises are among the important obstacles for the initiation of such partnerships. It is important that the brick factories operating in the sector come together and establish joint raw material preparation facility with the public support to gain competitive edge. Public institutions (Ministry of Science, Industry and Technology, KOSGEB) provide the necessary economic support to joint ventures for sectoral use under the name of the cluster. Sector representatives are required to take the necessary initial steps in a joint venture. Successful examples of joint ventures will be effective in spreading such initiatives throughout the country.

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