# Building an integrated vertical chain - a factor for sustainable construction

Aneta Marichova
*Associate Professor of Economics*
*Social Sciences Department*
*University of Architecture, Civil Engineering and Geodesy*
*Sofia, Bulgaria*

***ABSTRACT*** *-The concept of sustainable construction is increasingly affecting the development of the construction market.The specificity of construction as an economic activity and ofthe construction product (goods and services) determine the existence of a complex vertical chain of links, involving different actors, who tend to work in the short term and are limited to the rational use of knowledge and experience in practice. Moreover, it is characterized by a low level of inter-company relationshipsresulting in a fragmentation of responsibilityand complicates and hinders the realization of projects and sites,which meet the requirements of sustainable construction. Sustainable construction requires a holistic approach and substantial changes in the organization of construction activity, both at the market and firm level, under the active role of the state. The aim of the study is: 1) analysis of problems in the vertical chain of connections in the construction market, 2)an analysis of the possibilities for creating stable long-term relationships and a joint approach of clients, contractors and subcontractors, which can provide economic, social and environmental efficiency of the construction.*

***KEYWORDS*** *-**Bilateral Monopoly, Construction Firm-Buyer/Seller, Construction Market, Integrated Vertical Chain, Sustainable Construction***

## I. INTRODUCTION

General trend in the development of modern economies is increasing role of the market in the allocation and use of scarce resources. This means that the process is carried out from private individuals, companies, which in their behavior are mainly guided by their personal interest and the realization of higher profits. Sustainable construction is a long-term goal that requires a high level of knowledge, competence and interaction between all participants in the construction process.

According to analysts, the construction market is inefficientas participants tend to work in the short term, difficult to perceive innovationsand are limited rationalusing the accumulated knowledge and experience in their practice. A common feature is also the low level of inter-company relations, which means that the same team rarely works together more than one project. This complicates and hampers in practicethe realization of projects and sites,which meet the requirements of sustainable constructionand leads to fragmentation of responsibility.These problems are particularly visiblein ineffective vertical relationshipsbetween participating companies. In other words, each project involves companies that are collected temporarily only for the realization of the project and specific goals. At the same time, these firms are likely to be involved in other projects where they coordinate their actions and allocate resources to other companies involved in the supply chain. Each construction firm realizes simultaneously several different, individual projects within the framework of its more widely defined mission and vision for development, which requires coordinating its actions with other companies outside the scope of each project. Unlike the construction market, other industrial activities are characterized by relatively few independent elements and a much higher level of coordination and management that allows the use of standardized procedures and products and provides higher quality, improved management and economies of scale. This suggests that the construction market is necessary improvement of the level of communication between the participating companies, development of partnership, whether formally through contracts or simply achieved through informal relations, which allow the creation of multidisciplinary teams of investors, architects, designers, contractors, end-users at the very beginning of the project. A partnership is required, which means a joint approach by customers, contractors and subcontractors to optimize costs, create more value at each stage of the chain, deepen the specialization and differentiation of each

intermediate product, enhance the quality of the finished product, which can provide economic, social and environmental efficiency of construction.The vicious circle must break,in which construction companies say they can build sustainable,if customers want, customers want sustainable construction if they meet their wishes and provide the desired return on investment, designers are ready to design sustainably if investors are willing to pay,and investors are willing to pay if there is a demand for sustainable construction.

Realizing this goal is far from simple, especially when there is no trust and effective cooperation between the participants [1]. On the one hand, there is no commitment from larger contractors to subcontractors for training, education, innovation development, initiatives to improve organization and management of the activity, improvement of working conditions and environmental protection. On the other hand, the subcontractors (who actually carry out the projects) accept the projects they realize as prototypes, which is why many of the problems that have arisen during the implementation of some projects are not analyzed, but they are assumed to be normal functioning of the business. At the same time, solving a problem, a task in a single project, can and should be passed as a positive experience in subsequent projects. For this purpose it is necessary link between all participants sharing experiences and multiply each had a positive effect. Gathering information and revealing the essence of the problem can only happen with the active participation of all employees in a given company and the other companies participating in the vertical chain. Motivation and incentives for employees are a factor to overcome the problem and create a more efficient organization.

Many of the problems are created by other participants at other stages of the construction process, resulting from short-sighted vertical chain management and difficult to remove from one firm. Contractors and sub-contractors do not want to recognize the impact of their behavior on other activities and stages. As a result, the problems are solved in a piece for the moment, which means high costs and inefficiency. Furthermore, there is often a causal link between problems along the chain and solving a problem means awareness of dependence and acommon desire to overcome the problem through long-term cooperation, which is rarely happening.Theconstruction market prevailing short-term contract, which means that the parties have no interest in investing time and resources in such endeavors. Moreover, in the context of a decline in construction activity, short-term contracts allow the contractor to rationalize, optimize its activity by stopping it and reducing the number of subcontractors with which it works. This policy does not provide sustainability of construction in the long term and opportunities for quality improvement. The absence of a uniform standard,adequate legal norms,guidelines for design work,construction and maintenance of sustainable construction sitesdo not allow effective cooperation of all participants in the vertical chain of construction activities. These problems in the vertical chain of value creation in construction, objectively indicate a need for improvement and more effective management. The aim of the survey is: 1) analysis of problems in the vertical chain of connections in the construction market, 2)an analysis of the possibilities for creating stable long-term relationships and a joint approach of clients, contractors and subcontractors, which can provide economic, social and environmental efficiency, or sustainable construction.

## II. ANALYSIS OF VERTICAL CONNECTIONS OF THE CONSTRUCTION MARKET

The specificity of construction as an economic activity and the construction product (goods and services) determine the existence of a complex vertical chain of links, involving different actors, as buyers and sellers which create value at each stage of construction and perform different tasks and functions (Fig.1).

In this vertical chain main subject and factor is the investor - the person, which finances the entire construction activity own and credit funds. The investor may be public - the state or municipalities, or private, physical person - companies, households. Public investment in construction (mostly in infrastructure) depend to a large extent the possibilities of the state budget to fund major building projects the country's priorities in the given period, its fiscal policy and various political factors. Private investment in construction depends above all expectations of economic agents for future economic development, expected return from the construction object, the credit policy of the banks and many other primarily psychological factors. Investments in construction are investments in real capital, real assets, which means that they do not exist or rarely exist an element of speculative capital. On the other hand however, often the investment solution itself is speculative, resulting primarily from the impact of future expected factors risk assessment and expectations of high returns over a relatively longer period of time.

The creation of each construction product starts with the determination of the requirements, the preferences of the investor (client) regarding the construction site (area, technology, terms, quality, price). The expressed claims of each client are a function of his knowledge for about what is being sought on the market, with what technology can be realized. They find their place in the development of individual, unique construction project (from the

point of view of location, infrastructure, functionality, design, ecology, etc.), which embodies the highly qualified work of architects and designers/constructors. The created service-level project is re-supplied to the investor for corrections, changes and a final decision (to start or to refuse realization),which is broken down by its estimate of expected return, expected changes in economic conditions, expected changes in the market, etc. In this connection, the investor is a buyer and the construction company is a seller (vendor) of a service, commissioned an external investor. The contractor works with subcontractors to whom it entrusts the execution of certain tasks for the realization of the final product. The executive firm is now a buyer, and the sellers of the service are subcontractors. These are usually small companies who perform separate activities in which they are specialized or activities related to maintenance, repairs that are not of interest to large companies. The creation and realization of the end product means that the investor and the construction company are the sellers of this product to the end user (households, firms).Therefore, the participants in the construction process simultaneously perform the function of a buyer of a product from a previous participant and a seller of the product to the next participant. This means that in every unit from the vertical chain of relationships construction firm as a buyer of resources and services can be monopsony or oligopsony, on the other hand, as the seller of the created product may be in the role of a monopoly or oligopoly on the market [2], which substantially changes the behavior and conditions of market equilibrium.

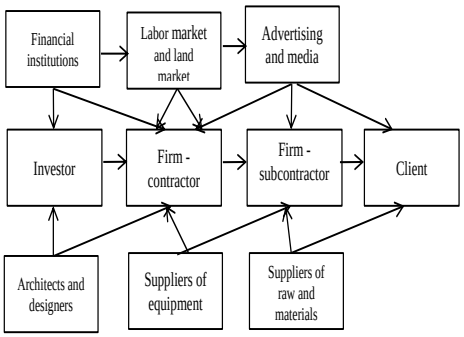


**Fig.1. Vertical connections between the different actors involved in the construction process**

At each stage of the construction process, construction firms - contractors and subcontractors use, combine in a certain way (depending on the technology chosen) different materials, labor, including the basic and most expensive resource - the land. They incur costs for their purchase from the respective suppliers and generate revenue from the product they sell. The volume of these costs and revenues is, in principle, a function of the specifics of the activity performed.

Every participant in the chain searches, collects, analyzes different offers from contractors and subcontractors, and chooses one to work with and control over its activities. This costs each company significant transaction costs (external) [3],which influences the formation of the final price of the construction product.

These specifics of the construction market require an in-depth analysis of the market activity of the construction firm at the entrance and exit. In addition, the construction market includes different market segments, both on the part of different buyers and their different behavior, both on the part of companies, offering different construction activities with different geographic, territorial locations. Every segment has a different number of buyers / sellers with different characteristics, different behavior formed under the influence of various factors, and mainly a function of the different competitive conditions, which determines their different market power.

In order to explore the real relationships and behavior of investors (clients), contractors and subcontractors as buyers and sellers on the construction market, we will accept the assumption that the two markets - the product and resource (factor) markets have a perfectly competitive structure and create an ideal market outcome. As a result of structural changes in the market/industry, the behavior of participants (buyers gaining market influence) and market equilibrium conditions changes.

### 2.1. Equilibrium in perfect competition of product and resource construction market

On the perfectly competitive construction market total demand is formed by all firms buyers a standardized construction product and the total supply is formed by the supply of all firms-contractors, sellers of the given standardized construction product. From the total demand and supply of the given standardized construction product, the equilibrium price and the equilibrium price, which is fixed and no buyer or seller can affect it.

The construction firm-buyer and a perfect competitor on the construction product market, aiming at maximizing profits to determine the optimum volume of construction output it will buy, must compare the *Marginal Revenue of Construction Product* - $\mathbf{MR_{CP}}$, that you will receive at the sale of the marginal/additional construction product with the price it has to pay or with the transaction external marginal costs to conclude the deal with the subcontractor and the purchase of the marginal additional construction product - $\mathbf{MC_{CP}}$*(Marginal Cost of Construction Product).*

The firm - a perfect competitor to the product construction market is the recipient of the

price of the created construction product, so that each unit of output, incl. and the last produced/additional will be realized at the determined market price of the product **$P_{CP}$***(Price Construction Product)*. The proposed marginal construction product – **MCP***(Marginal Construction Product)* multiplied by the corresponding market price of the product, will determine the marginal revenue of the buyer company: **$MR_{CP}$=MCP.$P_{CP}$.**

The marginal revenue from the construction product *($MR_{CP}$)*reflects the demand for construction output by the respective buyer and is graphically depicted with a negative slope search curve, because of diminishing returns to variable factor in a short run. At the market-set, fixed price, it can buy an optimal volume of construction output following the rule -equal marginal revenue with marginal transaction costs. If the marginal revenue *($MR_{CP}$)*from the sale of marginal/additional construction product is greater than the transaction costs the seller, the construction company will increase the volume of their purchases, and vice versa - if the marginal revenue from construction product is less than the transaction costs, it will reduce the volume of purchases (contracts).

The firm seller of construction product and the perfect competitor maximizes your profits by striving to equalize the marginal revenue - $MR_{CP}$ from the sale of an additional unit of construction output (equal to the price - $P_{CP}$ under perfect competition) with the marginal costs - $MC_{CP}$ (equal to the average cost and product price) for its creation - $MR_{CP}=MC_{CP}$. It determines the optimal volume of construction output it will offer and sell at this current market price, following the rule - the market price of the product (marginal revenue) is equal to the marginal cost of creating each additional unit product. If marginal revenue, i.e. the cost - $P_{CP}$ is greater than the marginal cost - $MR_{CP}=P_{CP}>MC_{CP}$, the company has an interest in increasing the volume of the product offered and vice versa - if $MR_{CP}=P_{CP}<MC_{CP}$, its interest dictates shortening the volume of the product offered(performed activities that are negotiated with the buyer). Therefore, the curve of offering the sales company of construction products in a market with perfect competition is the classic positive slope and shows a right connection between price and supply volume of output. The equalization of the total demand for construction products, determined by the marginal revenue from the construction product - $MR_{CP}$, which the buyer will receive and the total supply of construction output determined by the seller's marginal cost - $MC_{CP}$ determines the equilibrium price $P^*_{CP}$, the equilibrium quantities ($Q^*_{CP}$) and the equilibrium of the construction market (p. E), where buyers and sellers are perfect competitors (Fig. 2).

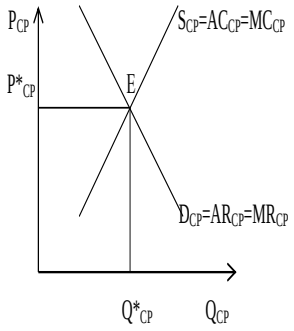


**Fig. 2. Equilibrium in perfect competition of product and resource construction market (buyers and sellers - perfect competitors)**

### 2.2. Equilibrium in imperfect competition of product and resource construction market

The equilibrium conditions of the construction firm, which is both a buyer and a seller in the vertical chain of links, are different when the product and factor markets are imperfectly competitive. In economic theory are three models with different degrees of imperfection.

The first model assumes that the firm has monopolistic impact of the product market (mainly driven by product differentiation or economies of scale),but in the resource market is a buyer-perfect competitor. The demand curve for its product has a negative slope, but for each level of production, the price is higher than the marginal revenue ($P_{cp}>MR_{cp}$) and hence marginal revenue curve deviates under the curve of demand for the product. Since the resource market has a perfectly competitive structure, total demand and supply of resources form the equilibrium price. The company is one of the many buyers on this market and it can't influence that price. With the current market price, the firm can buy as much as it wants, following the rule - the marginal cost of each resource unit is equal to the market price – MCcp=Pcp. Under the given conditions, the company - monopolist of the product market buys fewer resources at the specified market price, and sells the finished product at a higher price.

In the second model, the firm has a monopsony influence, i.e. there is only one big buyer of resources (including labor). In an imperfect competitive structure of the resource market, the supply curve of a resource (factor) is with the classical positive slope - if the company wants to increase the resource purchases, it will have to pay a higher price. With an increasing supply factor curve hiring an additional resource unitin creases overall costs with a higher magnitude,than the price increase because the higher price is paid not only for the last unit purchased, but for all previously purchased resource units. It follows that the marginal cost curve (reflecting the change in total costs resulting from hiring an additional resource unit) for

purchasing resources is growing and located above and to the left of the supply curve or above average labor costs. In a monopsony market, the firm realizes its monopsony power by purchasing less resources (defined by equality of marginal revenue with marginal cost) at a lower price - $MR_{CP}$=MCcp>Pcp, compared to a perfectly competitive market.

The third model analyzes the behavior of a firm (seller) with a monopoly influence on the product market and a monopsony influence (buyer) on the resource market, i.e. a combination of the previous two. Under these circumstances, the market is in equilibrium when the monopsony and monopoly company equals the marginal revenue from the end product with the marginal cost of purchasing the necessary resources for its production. Due to the monopolistic influence of the company on the product market the price of the created product is higher than the competitive price and the demand quantity is lower. Since demand for resources is a function of demand for the resource-produced product, and as a result of monopoly-monopsony power, the price and quantity of resources purchased are lower than the competitors.

**2.3. Behavior of the construction firm with a bilateral monopoly on the product and resource market**

The most common model of the construction market is the model that implies a market structure with two market participants, a monopoly on the part of the product market, and a monopsony on the part of resourcemarket. When a single seller (monopoly) and single buyer (monopsony) collide on one market, the market structure is defined as bilateral monopoly.

If the firm-buyer of a construction product is a monopsony and the construction firm- seller has a monopoly impact on the product market, their behavior changes substantially:

1) The construction firm-seller that has a monopoly/oligopoly influence on the product market, resulting from product differentiation, asset-specific differentiation or economies of scale control this market and has market power, that allows it to impose and maintain a price of the product offered higher than marginal revenue- $P_{CP}$>$MR_{CP}$. It will seek to negotiate with the company-buyer the volume of output it has to perform for which the marginal revenue is equal to its marginal cost of product creation (purchasing resources and organizing production subject to the buyer's requirements in the contract) - $MR_{CP}$=$MC_{CP}$ and a price - $P_{CP}$, at which to sell such output, higher than the specified equality - $P_{CP}$>$MR_{CP}$=$MC_{CP}$.

2) The construction firm-buyer of the construction product is monopsonic impacton the market.In thissituation, its search for a construction product with certain characteristics will be determined by the marginal revenue it will obtain from the realization of the product at a later stage, but because of the monopoly position of the seller, the market price for each quantity is higher than the marginal revenue for that quantity and therefore the marginal revenue curve is below the demand curve (average income).

On the other hand, the firm-buyer and monopsony is facing a supply (in this case a monopoly), which may itself and independently used in its own interest. It is well known that within the monopoly market structure for the monopolist there is no uniquely defined supply curve. Consequently, the marginal cost curve for production can also be seen as a curve, identical to its supply (with a positive slope and an expression of average costs). At the conclusion of the contract, the buyer is primarily interested in marginal (transactional, external) costs incurred by the transaction and which will compare with the marginal revenue from the realized construction product at the respective market price. Due to monopsonic position the buyer company marginal costs are higher than the transaction price (average costs) because the higher price applies not only to the last concluded transaction but also to all previous ones) and the marginal cost curve of the monopsony is above the supply curve of the monopoly.

3) The marginal costs and revenue allow to determine the decisions the participants in the dealshouldadopt in order to maximize their profits and achieve market equilibrium. The monopsony as the only buyer in the market, maximizes the profit in point A (Fig.3), where equalize the marginal revenue from the construction product determined by the demand for the product - $MR_{CP}$ with marginal costs - $MC_{CP}$ or $MR_{CP}$=$MC_{CP}$. The optimal volume of construction output from the monopsony will be $Q^*_{ACP}$ and the agreed price (on the supply curve) will be set at $P^*_{ACP}$ level.

The monopolist, as sole seller, maximizes its profit at point B(Fig.3), where marginal revenue MR equals with marginal costs $MC_{CP}$ (equal to average costs, product cost), or $MR_{CP}$=$MC_{CP}$. From the positions of the monopolist, the optimal level of production volume is $Q^*_{BCP}$, and the optimum price (lies on the search curve) is $P^*_{BCP}$.The optimum price $P^*_{APS}$ for buyer-monopsony determines the lower (lowest) limit to which the market price of the resource may fall. It can only be achieved if the seller-monopoly is forced to act as a perfect competitor. The optimal price $P^*_{BCP}$ for monopoly - selling is upper (highest) price limit that can be achieved if the buyer-monopsony is forced to act as a perfect competitor.

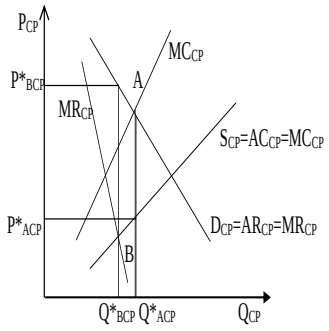


**Fig. 3. Equilibrium of the construction market with bilateral monopoly (monopsony buyer and seller-monopoly)**

The analysis of market behavior in this case can't give a single answer about what the equilibrium price and quantity will be since the different objectives of the two parties with market power on both markets can't be realized at the same time. Under these conditions can only determine price limits (between $P^*_{ACP}$ - $P^*_{BCP}$) within which the negotiations will be conducted between the participants - the construction firm-buyer and the construction firm-seller. The level of which will be determined agreed price depends on the skills and strength to bargain the buyer and seller, as well as the specifics of the construction market segment:

Many large, small, equivalent sellers are operating on the housing market in an effective monopoly competition. The large number of buyers (each household in the country is a potential buyer in this segment) have an ever-increasing market impact and opportunities for imposing conditions and prices on the conclusion of contracts. Construction companies can respond to increasing market power to buyers by improving, developing and differentiating their product and activity and creating loyal consumers.

In the market for non-residential construction, buyers are usually several large investors - oligopsony, with significant market power. They almost always one-sidedly define the parameters of the transaction and impose their requirements for quality, price, timeliness of the projects and objects. The buyers (oligopsony) usually work with several firm (sellers) based on repeated contracts, transaction specifics, and experience. The effect of this specialization is the differentiation of the company's product and the increasing monopoly power of the seller.

In the civil construction market, the buyer is always only one - the assignor, in the face of various state institutions. This is a typical monopsony market with a large market power that fully determines the operating conditions of construction companies. A seller on this market is a large company (monopolist, which reduces the market power of the buyer) with differentiated assets and specialized in the construction, which works with various small contractors and subcontractors. In this case, a typical bilateral monopoly in both markets the final result in terms of agreed price and volume of work is usually similar to the ideal market outcome (effect) in the perfect competition, which increases economic efficiency.

Therefore, the different market segments the buyer and the seller have different market power, and the final market outcome (price/quantity) depends on which of the parties will take leadership positions in pricing, although none of the price options dictate prevents the realization of maximum aggregate profit. In a market with a bilateral monopoly the interests of both participants with market power obviously difficult to realize at the same time. The buyer's power must be sufficient to prevent monopoly increases seller's prices, and the seller's power must be sufficient to prevent monopsony high prices from the buyer. Higher efficiency and sustainable construction can be achieved by improving of the vertical relationships between all participants in the construction process, which allows a reduction in the market power of the buyer and the seller.

## III. BUILDING AN INTEGRATED VERTICAL CHAIN – A FACTOR FOR SUSTAINABLE CONSTRUCTION

Problems in the vertical chain of connections in the construction market, the impact of unfavorable factors make the seller and the buyer look for a relatively stable relationship. The choice of vertical relationships for each firm depends on the nature of the relationship between the firm and its partners (buyers and suppliers) and is determined by the frequency and complexity of the transactions between the two parties (Fig. 4). Market transactions are preferred for occasional or regular transactions, which are the subject of these transactions - a product with common features. The specificity of the transaction, the product subject to the transaction and its increasing frequency imposes the vertical integration policy as the most effective.The integrated vertical control chain and the system of vertical connections and constraints occupy an intermediate place but have a growing importance in company policy and practice, both because of the higher end efficiency and because of the limitations and control of vertical mergers imposed by antitrust law in each country.

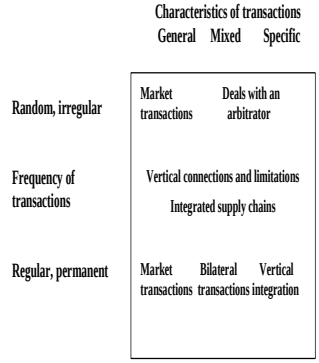


**Fig. 4. Selecting the vertical relationship of the construction company**

The process of vertical integration is mainly aimed at uniting the successfully functioning units of the production process into a single chain. Due to the specifics of the construction market there are four types of transactions that make vertical integration particularly effective [4]:

1) Transactions that require the use of specific assets by the seller or buyer. The specificity of the company assets is one of the main motives for vertical integration. These transactions include specialist vendor assets that are used only by a few buyers or physically specialized, specific buyer assets that require specific resources provided by a small number (often a single supplier) of suppliers and also the specialization and specificity of the human resources used in a given production that are acquire only subject to the requirements of the buyer.

2) Uncertainty of the deal, which makes control very difficult.

3) Asymmetry of information received by the buyer (when the resource provider presents true but incomplete information to their partner).

4) Need for extensive coordination, which means high costs and time to realize the goal.

The main reason for the vertical integration of companies is the increase in transaction costs. Merging with subcontractors and/or suppliers and/or distributors reduces these costs and turns them into internal company costs.

In addition, control over important raw materials can provide the company with competitive advantages over other companies that are now denied access to this source of raw materials. Vertical mergers with feedstock suppliers create prerequisites for increased costs for competitors' production or penetration costs for new firms.

Through the merger, the suppliers become employees of the company which ensures their loyalty and reduces asymmetry of information. On the other hand, vertical mergers of companies enable rhythmically to be supplied with vital raw materials, better control over the quality of raw materials used, and reduction of production and transport costs.

Most often, vertical integration with sellers (resource providers) or forward with buyers leads to an increase in production capacity, technology competencies of the company and creates opportunities for using and transferring larger cash flows between individual enterprises and stimulating research and innovation. So large, leading construction companies create complex holding structures, which bring together a large number of subsidiaries, specialized in a particular activity from the different stages of the construction process or in the production of a product for a particular market segment. This is also proof of the high degree of horizontal integration achieved in them, which is an important condition for their higher efficiency - achieved economies of scale, pooling more financial resources and flexibility, adaptability to market changes. In addition, these companies include in their structure and companies related to the investment activity, the valuation and realization of real estates and of course the production and trade of building materials. These processes of horizontal and vertical mergers cover the whole process of vertical links in the construction market and reduce the monopoly power of suppliers and buyers.

Because of the high resource intensity of construction activity, the construction company links as buyers of building materials with its suppliers are particularly important. The supply of building materials is carried out by several large companies involved in an oligopoly structure (the concentration of this market reaches 60-70%) which are the active part of the entire construction process. These companies realize significant economies of scale and have high production potential, which is an important factor in reducing costs and hence in raw material prices. In turn, construction companies (contractors and subcontractors) also aim to reduce their costs (usually by around 20-30%) and provide timely, reliable supplies and receive materials, different components at a lower cost, at best, favorable conditions for the payment of credit. Large construction companies negotiate directly with large manufacturers or wholesalers at discounts for large purchases. The highly concentrated market, with low competition between the suppliers of building materials on the one hand and on the other hand the low concentrated and high competition construction market, gives the impression that strong suppliers exercise their market power. Practice shows that the suppliers of building materials do not use or impose a monopoly or oligopolistic power on the construction market. For these reasons, large unions of suppliers of building materials and construction companies are rare in practice.

Large construction companies build their own production bases for building materials, near the territory where they are localized, which provides them with stability, rhythmic delivery and, most importantly, lower transaction and transportation costs or buy small companies - manufacturers of building materials.Similarly

develops and integration forward with distributors, real estate agencies.

In today's conditions, the most effective form of development of vertical relationships in construction that creates competitive advantages is the system of vertical connections and constraints and the integrated vertical chain. The vertical connections are relations of control and constraints in the activity of two independent, independent construction companies, which participate in successive stages of the production process. Vertical constraints help solve mismatches which derive mainly from asymmetry of information. In a relationship between a buyer and a seller of a construction product, asymmetric information can lead to the problem of "principal agent", which means one company to realize the benefits of the other company without paying for it.

A particularly effective form of interaction between all companies involved in the vertical chain of construction activities is the integrated vertical chain. It is a network of firms, organizations, activities that engage in links - up and down in different processes and create value in the form of end-user products and services. Thus, the scope of chain management covers the production and supply of materials, the production of the next product, the end product and its realization to the end user. Every participant in this chain depends on the other participant and active cooperation is needed in order to achieve higher efficiency. This cooperation is achieved through long-term relationships, connections, seamless collaboration and information sharing.

Firms in the integrated vertical chain share information and coordinate within the established chain, providing maximum benefit to all participants. Furthermore determine accurate assessments for execution of transactions and to assess the effectiveness of the chain. The final results in integrated vertical chains are an improvement in customer service, reducing inventories throughout the chain, offering a better product, realizing higher profits throughout the life cycle of the product and build a competitive advantage for participating companies.

The integrated vertical chain implies competition with other chains, not between companies, which allows to achieve:

1) Higher efficiency of logistics, which includes planning, organization, coordination and control over the performance of the obligations of each participating company. The basis for this is the permanent links and the exchange of information between the participants - the construction firm-buyer and the firm-seller (contractor, subcontractor or supplier of building materials).

2) Establishing long-term partnerships between all participating companies based on commoninterestand good personal relationships, which is factor for joint problem solving, information sharing and risk. In view of the good end result, the active participation of suppliers of building materials is particularly important throughout the process - from design to realization of the object together with the construction contractor. This reduces costs by up to 10% and increases productivity.

The basis for effective joint work in the integrated vertical chain is trust. Effective connections between all participants combined with effective management of all units of the vertical chain with other good practices of customer relationship management ensures greater competitiveness on the market and allows creating a high quality, differentiated product with specific features desired by customers, as well as a reduction in production costs and the price.

*Efficiency in the integrated vertical chain is a function of cooperation and long-term contracts, long-term relationships, links, continuity of collaboration, information exchange and trust.Building and efficient management of the integrated vertical chainbased on competition, is an important factor in stimulating innovation,especially "open innovation",reducing the asymmetry of information and transaction costs,increasing specialization,technology development inside and outside the companyand their use in creating the final construction product.*

The final construction productsdemanded by consumersare a complex system of different elements, components, parts with a strong functional dependence, which largely determines and the need for unificationbetween more independent companies in the vertical chain and allows application and development of best practices in the design, implementation, maintenance and reconstruction of buildings. Standard building practices, led by short-term economic goals often show little concern for energy efficiency or even more so for the economic, social or environmental impact of the built-up area. Sustainable construction is trying to end these practices by integrating a wide range of design, construction, operational and maintenance practices to provide a healthier life, a better work environment, and reduce environmental impact. An important factor is the development and implementation of *Integrated Design Principles* - the approach to completed building systems,gathering key entrepreneurs and professional designersto work together from beginning to end. With the traditional design approachthe ability to evaluate a buildingin the initial phase as a whole is quite small. The uncoordinated work of different designers leads to permanent repairs and sometimes the necessary changes are noticed too late, barely when construction begins and removing them can be much more expensive. Therefore sustainability in constructionstarts from the earliest stages of the

projectand requires responsible engagementof all participants in the process: investors and clients, architects, designers, construction firms-contractors and subcontractors, suppliers of raw materials, administrative authorities, lawyers, researchers, which in fact means creating of an integrated vertical chain and substantial changes in the organization, coordination and management of the construction company at all levels.

Integrated vertical chainallowsthe implementation of *the Integration and Co-operation Strategy*,which is particularly important todaydue to the fact that most innovations are complementary and not interchangeable. Complementary innovations are the result of a chain reaction, triggered by the emergence of an innovation and the existence and development of complementary, specific assets in different activities or different companies, and any such specific asset is the result of another such specific asset and can't independently fulfill its purpose. The interdependence of specific assets also implies the creation of a package of complementary products (goods and/or services) that increase the satisfaction of the end customer. The ability of managers to identify, develop and use their specific assets in combination with other specific assets of other companies, participants in the vertical chain of created value it is unique and often very difficult to realize. Integration and Co-operation Strategy allows a firm to specialize its assets and use them more efficiently with a new combination and joint use with other specialized assets from other companies, which is a factor for realizing economies of scale and offering an integrated solution for customers.

One major opportunity to improve the links between the firms in the vertical chain and especially for the development of the small subcontractors is to unification with other companies and create *strategic alliances*. They are defined as "voluntary partnerships between firms on the basis of contractual relationships that allow for development and change through cooperative production and the development of the end product created through the transfer of technology, knowledge and services" [5], with the participating companies retain their relative independence in the time of its existence, i.e. are practically excluded and no merger and takeover processes are observed.

Strategic alliances can be realized both between companies that are equal partners and between companies with different market positions and potential [6]. If a small company participates in a union with a big, established firm on the market, it gives it access to the experience of the big ones, to the "good practices", the opportunity to improve the internal organization, to improve its activity, to expand the knowledge and to create a new, allowing initiate necessary changes. The creation of an alliance involving small, medium, equivalent firms limits the potential, reduces the flexibility to the dynamics of the environment and their future development. A small business has a chance to succeed if it participates in a strategic alliance where other actors have innovative capabilities and therefore the potential for technological and market change.

If for small business players in such a system the result is a better business and learning of "good practices", for big, key players, building these relationships is an opportunity to realize economies of scale and/or economies of scope, reducing switching costs associated with choice of suppliers and other contractors, which stimulates the development of innovations in a product, technology, and allows the creation of a higher added value for customers and thus the realization of higher profits. An important factor in achieving the desired success, greater than the success that can be realized in each individual company taken or a synergy effect is the realization of the necessary control and coordination of the overall activity.

The links in the strategic alliance are developing on the activities of the included firms that create separate parts, elements, components of the final general product. The company leader, a key player, sets the standards, the product requirements created at each stage of total production. Under these conditions, the small company must develop and deepen its specialization and differentiation of the created product. Realizing a common objective requires maintenance of formal and informal links between different companies and personalities based on the generic resource created by acquiring different assets. A key success factor is access to information, experience and their exchange in order to solve current problems. Building effective links at all levels, formal and informal, the trust between all subjects is critical for each union.

The unification between companies can to ensure a more efficient allocation and use of scarce resources, the realization of a synergistic effect in one or more companies, successful adaptation to external changes, through know-how, knowledge sharing, information, technology and products, which in turn increases the productivity and effectiveness of vertical links.

A more effective partnership between the public and private sectors can also be realized by creating a construction cluster, which includes interconnected companies/subjects, involved in the vertical chain of created value - construction company with strong positions (leader), investors, suppliers of construction equipment, raw materials, architectural and design offices, contractors and subcontractors, distributors, marketing and advertising agencies, state and local public institutions, universities, research units, construction (branch) organizations, each with specific rights and obligations. Clusters are geographically concentrated

associations (region, state, or even a city, and may be extended to neighboring towns, regions, or even neighboring countries), which primarily recognize the priority of education and research and provide specialized training, education, information, research, technical support of the participating firms and whose activities as a whole are developed on competition and cooperation [7].

The efficiency of clusters is due to the applied integrative approach to various activities, projects that are interconnected, complementary. The main factor ensuring the efficient functioning of the construction cluster is the availability of a basic, leading company (often called anchor), well-built infrastructure, access to markets, raw materials, social services and financial resources. Most cluster participants are not direct competitors, they work on different market segments, have common problems, opportunities and threats in their business. Practice proves that the success of the cluster is primarily a function of the development and use of intangible assets (innovation, knowledge and education) that are the basis for building an effective system of inter-firm relationships on trust.

Opportunities for coordination and mutual improvement of activity in each cluster reduce the risk of ineffective competition or limiting the intensity of rivalry. The realization of these processes depends to a great extent on the built personal relationships, communication and networks of private persons and institutions. Close links with buyers, suppliers, and other institutions are an important factor for the realization of competitive advantages company goals, while at the same time the system does not exclude competition between participating companies, on the contrary- it implies. Especially important is the availability of an educated workforce, proximity to research, higher education, an entrepreneurial spirit and culture that values education and knowledge. These services must be provided by public institutions.

The public sector plays the role of an intermediary between participating private firms, a role of initiator of programs and concrete implementation plans, a listener of problems that need to be quickly mastered and resolved. Public institutions at national or local level have three main objectives:

1) Ensure cooperation, interaction and equality to all actors involved and to create conditions for a strategic partnership.

2) To maintain the necessary infrastructure - transport, social and opportunities for permanent development, training and raising the qualification of the required workforce.

3) Ensure coordination of the different programs and funding of interconnected activities, not individual activities and projects that are isolated from one another.

Interaction, cooperation and competition with all participating companies in the construction cluster requires the creation and implementation of new business models, where specialization, the development of open innovation of the company and its co-operation with other interconnected and complementary companies and assets are central. The creation of the construction cluster facilitates the creation of an effective integrated vertical link system, because it includes from related and supporting the main production activities, "from the development of innovation and the idea to its realization".

## IV. CONCLUSION

Requirements and principles of sustainable construction impact more and more on the overall construction process -from the design, construction, exploitation and destruction of a building and require effective cooperation of all participants in the vertical chain of construction activities. The object of study in the article are the complex relationships between the companies participating in the vertical chain of value creation in the construction. The specificity of construction as an economic activity and of the construction product (goods and services) determine the existence of a complex vertical chain of links, involving different actors, which they perform simultaneously the function of the buyer of the product from a previous participant and vendor product to the next participant. In practice, this means that in every unit of the vertical chain has conditions for bilateral monopoly - the construction company as a purchaser of resources and services can be a monopson or oligopson,and on the other hand the exit,as the seller of the created product may be in the role of a monopoly or oligopoly on the market,with significant market power which it determinesand the main problem of vertical links. The buyer's power must be sufficient to prevent monopoly increases seller's prices, and the seller's power must be sufficient to prevent monopsony high prices from the buyer, which is a factor in increasing the economic efficiency of the market, and improving the relationships between the participants in the vertical chain.

The problems show that it is necessary link between all participants sharing experiences and multiply each had a positive effect. The final construction products which are in demand by consumers are a complex system of different elements, components, parts with strong functional dependence, which to a large extent defines and the need for unification between most independent firms in a vertical chain, and is a factor for the application and development of best practices in the field of

design, construction, maintenance and reconstruction.

There is a need for partnership, which means a joint approach of clients, contractors and subcontractors in order to ensure the economic, social and environmental efficiency of the construction. In modern conditions, the most efficient form of development and improvement of vertical relationships in construction is the integrated vertical chain. Integrated vertical chain is based on competition and includes a network of companies, organizations, activities that cover the entire construction process (from production and supply of materials, the production of various intermediates, to the creation of the final product and its realization) and create value in the form of end-user products and services. Efficiency is achieved through cooperation and long-term contracts, long-term relationships, links, continuity of collaboration, information sharing and trust. The establishment and effective management of an integrated vertical chain of links and competitive relationships is an imortant factor in stimulating innovation, especially "open innovation", reducing information asymmetry and transaction costs, increasing specialization, developing technology inside and outside the company and their use in creating the final construction product.

The study shows that the construction marketit is necessary to improve the level of communicationbetween participating companies, partnership development,whether formally by arrangements (strategic alliances, construction cluster)or through informal relationshipswhich allow the construction of multidisciplinary teamsright from the beginning of a project,whose main purpose is to create an objectmeeting the requirements of sustainable construction.Sustainable construction requires the commitment of all participants in the process from start to finish: investors and clients, architects, constructors, contractors and subcontractors, suppliers,administrative authorities, researchers, which in practice means building an integrated vertical chain.

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