

EXPLORING FACTORS AFFECTING SUPPLY CHAIN RELATIONSHIPS CONSTRUCTION

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Abstract. Managing business relationships between the parties in construction supply chains (CSCs) is the essential element of construction supply chain management (CSCM). Therefore, in order to have success in the CSCM, the relationships between the parties should be noticed. This study aims to identify and discover important factors affecting supply chain relationships in construction. The study identified 12 key factors affecting the supply chain relationships in construction and ranked them according to their degrees of impact. The findings showed that “working relationship”, “top management support”, “trust”, “business attitude”, and “communication” are the five most influential factors. The study can be considered as valuable additional contribution to the body of knowledge relating to the CSCM. The findings could help practitioners to have an insight into the CSCM and obtain success in managing the CSCs.

Keywords. supply chain management, construction supply chain, supply chain relationships, construction supply chain relationships.

1 INTRODUCTION

Supply chain management (SCM) is extremely current due to its success in other industries and therefore considered to be the future of construction [1]. However, as compared with the manufacturing industry, the application of SCM in construction is comparatively new subject and so far only limited studies and research has been conducted [2]. The construction industry is project-based with temporary organization and discontinuous nature, project-unique design and material specifications with little or no repeatability. The construction supply chain (CSC) is volatile, unpredictable, and the product environment is relatively unstable. Therefore, the SCM implementation in construction might be more difficult and it is impossible to use SCM principles from other industries to apply the same for the construction context.

In order to have success in construction supply chain management (CSCM), the relationships between the parties should be noticed. Managing business relationships between customers and suppliers at different tiers is the essential element of SCM. SCM is as the management of supply relationships [3]. Hence, it is necessary to discover factors affecting relationships between the parties in the CSC. This will help practitioners to have an insight into the CSCM and obtain success in managing the CSCs. The objectives of this paper are to identify and discover important factors affecting supply chain relationships in construction.

2 LITERATURE REVIEW

CSC relationships among the parties span over from a traditional adversarial relationship to a collaborative relationship. Partnering in construction can be considered as a collaborative relationship in the CSC. Supply chain collaboration is defined as a partnership process where multi-autonomous firms work together to plan and execute supply chain operations to get common goals and mutual benefits [4]. Many researchers argued that partnering in construction can significantly improve the relationships among the parties in the project [5], [6]. So by investigating the key aspects of partnering and the traditional adversarial relationships, the influencing factors on supply chain relationships can be identified [7]. The key aspects of partnering that are examined include the success factors for partnering and the factors that result in unsuccessful partnering. When partnering is unsuccessful, the relationship among the parties goes back the traditional adversarial relationship. This study performed a comprehensive literature

review on two resources, including (1) the success factors for partnering and (2) the factors that lead to the traditional adversarial relationship or unsuccessful partnering to identify factors affecting CSC relationships.

Regarding the success factors for partnering, for example, Black et al. [8] collected the opinions of different types of organization - clients, contractors, and consultants, to discover the success factors and the benefits of partnering in construction. The key success factors that were identified in the study include mutual trust, effective communication, commitment from senior management, acting consistently with objectives, dedicated team, flexibility to change. Similar studies were reported by other researchers such as Cheng and Li [9], Chan et al. [10], Lu and Yan [11], and so on. The success factors for partnering and the frequency of their citation were summarized in Table 1.

Table 1: The success factors for construction partnering.

Success factors for construction partnering	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	Mutual trust	Effective communication	Mutual objectives	Problem resolution	Risk allocation	Teamwork	Win-win attitude	Top management support	Sharing resources	Continuous improvement	Long-term commitment	Learning and innovation	Good cultural fit	Flexibility to change	Financial security	Effective coordination	Partnering agreement	Partnering experience	Empowerment
Crane et al. (1999)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>							
Black et al. (2000)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>
Cheng et al. (2000)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>			
Kwan and Ofori (2001)	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>										
Cheng and Li (2002)	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Naoum (2003)	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>									
Palaneeswaran et al. (2003)	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>		<input type="checkbox"/>				<input type="checkbox"/>								
Packham et al. (2003)	<input type="checkbox"/>					<input type="checkbox"/>	<input type="checkbox"/>												
Chan et al. (2004)	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>					<input type="checkbox"/>			
Chen and Chen (2007)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>
Jones and Kaluarachchi (2007)		<input type="checkbox"/>						<input type="checkbox"/>			<input type="checkbox"/>								
Lu and Yan (2007)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>							<input type="checkbox"/>	<input type="checkbox"/>	
Chen and Wu (2010)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>
Ghaffari (2015)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>			
Dogan et al. (2015)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					<input type="checkbox"/>			<input type="checkbox"/>					<input type="checkbox"/>			
Total	14	12	10	7	4	8	3	11	9	7	9	4	3	3	3	5	2	2	3

Partnering is not always successful. Some problems can hinder the adoption of partnering approach. Other researchers investigated the factors that result in unsuccessful partnering. For example, fifteen problematic issues were identified from six contractors involved in unsuccessful project partnering relationships [12]. Some problems occurred in all stakeholders specific such as lack of continuous open

and honest communication, lack of win-win attitude, lack of commitment to the partnering arrangement, lack of intimacy in the partnering relationship, ineffective problem solving, and unwillingness to compromise. Another research was conducted by Chan et al. [13] in Hong Kong. The survey findings of the research indicated that facing commercial pressure to compromise on the partnering attitude, little experience with the partnering approach, and uneven levels of commitment among project participants were the three most important problems that lead to the failure of construction partnering. Some authors discovered the factors that lead to the traditional adversarial relationships such as Gardiner and Simmons [14], and Thomas and Thomas [15]. A summary of the factors that lead to traditional adversarial or unsuccessful partnering and the frequency of their citation were presented in Table 2.

Table 2: The factors resulting in traditional adversarial relationship or unsuccessful partnering.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Traditional adversarial relationship or unsuccessful partnering	Lack of trust	Poor communication	Self-objectives	Ineffective problem solving	Unfair or unclear risk allocation	Fragmentation and lack of teamwork	Win-lose attitude	Lack of top management support	Lack of sharing resources	Lack of continuous improvement	Short-term focus	Lack of learning and innovation	Low or uneven commitment	Commercial pressure	Misunderstanding of partnering	Overdependency on partners	Checking or monitoring	Improper organization structure	Not familiar with partnering	Underestimating change scale
Larson (1997)	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								<input type="checkbox"/>			
Boddy et al. (1998)				<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>				<input type="checkbox"/>					<input type="checkbox"/>				<input type="checkbox"/>
Gardiner and Simmon (1998)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>												<input type="checkbox"/>				
Thompson and Sanders (1998)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>									
Akintoye et al. (2000)		<input type="checkbox"/>					<input type="checkbox"/>	<input type="checkbox"/>					<input type="checkbox"/>		<input type="checkbox"/>			<input type="checkbox"/>		
Bresnen and Marshall (2000)	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>										<input type="checkbox"/>					
Ng et al. (2002)	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					<input type="checkbox"/>							
Chan et al. (2003)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
Thomas and Thomas (2005)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>								
Wood (2005)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>													
Bennett and Peace (2006)		<input type="checkbox"/>				<input type="checkbox"/>			<input type="checkbox"/>					<input type="checkbox"/>			<input type="checkbox"/>			
Eriksson et al. (2008)	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						
Pryke (2009)	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>										
Le-Hoai et al. (2010)	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					<input type="checkbox"/>					<input type="checkbox"/>	
Total	10	9	9	7	9	6	9	4	5	4	4	2	4	4	3	3	2	2	2	1

Based on a comprehensive review of the literature on two above-mentioned resources, the top 12 key factors affecting CSC relationships were identified as shown in Table 3. These 12 factors were extracted because: (1) the total frequency of their citation from two resources implied that they were most frequently identified by different researchers, which meant that they might be more important than other factors; (2) they were identified on both positive side and negative side, whereas other factors were only identified on either positive side or negative side; (3) some other factors can be covered by these 12 factors, for example, “effective coordination” can be covered by “communication”, “low or uneven commitment” can be covered by “length of commitment” and “partnering agreement” can be covered by “goals and objectives”. Although, there may be an interrelationship among some of the factors, it is appropriate to consider them separately because each factor represents a main aspect of a supply chain relationship. For example, open communication requires mutual trust, but trust cannot replace open communication. Even if mutual trust exists among the parties, there is still a need to pay attention to open communication skills. Another example is that continuous improvement needs learning, and learning and innovation can promote continuous improvement. These are similar to time and cost being considered as different performance indicators although they are related each other [16]. As a result, there is no overlap among factors.

Table 3: Twelve key factors affecting CSC relationships.

Code	Factors affecting CSC relationships
R1	Problem solving/conflict resolution
R2	Trust (mutual trust or suspicion/mistrust)
R3	Goals and objectives (common or self-objectives)
R4	Communication (open and effective or ineffective)
R5	Business attitude (win-win or win-lose)
R6	Length of commitment (long-term or short-term)
R7	Risk allocation/sharing risks
R8	Continuous improvement
R9	Working relationship (teamwork or fragmentation)
R10	Top management support
R11	Learning and innovation
R12	Sharing resources

3 METHODOLOGY

To achieve the objectives of this study, a survey questionnaire was designed to gather views from industrial practitioners. The development of the survey questionnaire was supported by the literature review. A preliminary set of factors was collected from the literature review and presented in the pretest questionnaires. A pilot study was then carried out to validate the survey questionnaire with five experts who had at least fifteen years of experience in the construction industry. The experts were asked to comment on the readability, comprehensiveness, and accuracy of all questions in the pretest questionnaires. Moreover, they were also asked to remove any factors perceived as being inappropriate and add other factors perceived as being necessary. However, the experts did not make significant additions. They believed that twelve key factors identified from the literature review can be enough for most aspects affecting CSC relationships and it is not necessary to remove any factors in the pretest questionnaire. According to their comments, there were some minor adjustments in the structure of the survey questionnaire and revision of wording in the questions. The finalized questionnaire includes twelve key factors affecting CSC relationships.

CSC is relevant to all members of the construction industry (owners, contractors, subcontractors, designers, suppliers, etc.). This study concentrated on four principal categories of respondent: owners, contractors, designers and consultants. Respondents were asked to assess the degree of impact of the 12 key factors on supply chain relationships in construction. The 12 key factors were rated according to a five-point Likert scale ranging from 1 (not impact) and to 5 (extremely impact). A total of 400 survey questionnaires were distributed via electronic mail to respondents in Vietnam. Out of 400 survey questionnaires distributed, 127 valid responses were received, representing the response rates of 31.75%. The response rate was acceptable compared with the norm of 20–30% with most questionnaire surveys in the construction industry [17].

The valid data set collected from the questionnaires was then analyzed on Statistical Package for Social Sciences (SPSS version 20) software. First, the reliability of the five-point scale used to measure factors was determined using Cronbach's coefficient alpha. The "mean score" method is adopted by many studies to establish the relative importance among the factors. The key factors affecting supply chain relationships in construction are analyzed using the same technique. The five point Likert scale described previously was used to calculate the mean score for each factor, which was then used to determine the relative ranking of different factors by comparing the individual mean score for each factor in descending order of importance.

4 DATA ANALYSIS AND DISCUSSION

4.1 Profiles of respondents

A frequency analysis was conducted for the profiles related to the general information about the respondents. The highest number of questionnaires received was from the contractors (41.73%), followed by the owners (23.62%), the consultants (22.84%), and the designers (11.81%). In terms of designation of respondents, directorate, construction manager/project manager, and specialists having a certain level of professional knowledge, ability and maturity account for nearly half (44.88%) of the respondents. Civil engineer/architect, site engineer/site supervisor, and other (quantity surveyor, project engineer) account for 14.96%, 30.71%, and 9.45%, respectively. In terms of years of experience, the number of respondents having experience from 5 to 10 years, 10 to 15 years is 49.61%, 23.62%, respectively and more than 15 years as 14.96%. They account for a large rate of the respondents. Thus, the collected data are reliable and valuable. The respondents with less than 5 years of experience account for only 11.81%.

4.2 Ranking of the key factors affecting supply chain relationship in construction

A Cronbach's alpha of 0.893 for the 12 key factors was computed, which is above the recommended threshold value of 0.7, confirming the reliability of the five-point scale measurement [18].

Table 4 shows the statistical mean, standard deviation of the 12 key factors. The standard deviation (SD) on a factor represented a degree of consensus among respondents, while a mean response on the scale was an indicator of the degree of a factor's importance in relation to other factors [19]. The SD values of the factors are less than one, which reflects some consensus among the respondents [20]. The mean scores of the 12 key factors range from 3.45 (learning and innovation) to 4.21 (working relationship). It can be seen that their mean scores are higher than the mid-point score of 2.5 in a five-point scale. This can be indicated that, as a whole, the respondents agreed that the above 12 key factors affect the supply chain relationships in construction.

Table 4: Ranking factors affecting CSC relationships.

Code	Key factors affecting CSC relationships	Mean	Standard deviation	Rank
R9	Working relationship (teamwork or fragmentation)	4.21	0.86	1
R10	Top management support	4.19	0.90	2
R2	Trust (mutual trust or suspicion/mistrust)	4.17	0.82	3
R5	Business attitude (win-win or win-lose)	4.15	0.89	4

Code	Key factors affecting CSC relationships	Mean	Standard deviation	Rank
R4	Communication (open and effective or ineffective)	4.09	0.89	5
R3	Goals and objectives (common or self-objectives)	3.92	0.75	6
R1	Problem solving/conflict resolution	3.85	0.82	7
R12	Sharing resources	3.77	0.94	8
R7	Risk allocation/sharing risks	3.72	0.92	9
R6	Length of commitment (long-term or short-term)	3.69	0.84	10
R8	Continuous improvement	3.54	0.93	11
R11	Learning and innovation	3.45	0.93	12

All respondents ranked the “working relationship”, “top management support”, “trust”, “business attitude”, and “communication” to be the most influential factors. “Working relationship” was ranked top by all respondents, implying that working relationships between the parties are of paramount importance for SCM. The parties are used to working in opposition to each other, fragmentation, achieving individual objectives, rather than working together towards a joint objective. The uncooperative behavior and adversarial relationship among the parties is the cause of many various kinds of waste [21]. Teamwork would lay the foundation for good relationships between parties. The CSC relationships will be improved gradually better when it is started with the integrated team culture that is characterized by collaborative working instead of conflict, confrontation and fragmentation. In order to work together closely, joint decision making is a necessary process. The purpose of joint decision making is to adopt a more productive strategy and to find a mutually agreed solution [10].

“Top management support” and “trust” were ranked second and third, respectively. Commitment and action by the senior management can have a strong impact on the team and relationship management culture, indicating relationship management has a high chance of failure when there is inadequate support from top management [22]. Cheng et al [7] considered that, as senior management formulate the strategy and direction of business activities, their support, enthusiasm and commitment are vital for partnering success. Akintoye et al. [23] identified that top management support is the third most important factor for effective CSC relationships, and the biggest barrier to implementing successful supply chain collaboration is a lack of top management commitment. For relationship management to be effective, the parties need to build up mutual trust [10]. A lack of trust is a major barrier to the collaborative relationship [24]. Mutual trust can help the parties to increase information exchange and joint problem solving and bring better outcomes. Through establishing trust, organizations begin to develop confidence in each other, which gradually influences them to merge their boundaries, and finally trust encourages parties to make their merged boundary more permeable, allowing active inter-organizational exchange [25].

Next, “business attitude” was ranked fourth. Business attitudes may be either win-win or win-lose. Win-lose is a zero-sum game in which one party’s gain is the other party’s loss. Win-lose results in an adversarial relationship between the parties [8]. On the contrary, win-win is a positive-sum game in which both sides have gains. However, Cox et al. [26] pointed out that it is almost impossible to achieve win-win in practice. Win-partial win and partial win-partial win may be more feasible. Win-partial win means that one party achieves more than the other. One party achieves almost all objectives while the other only achieves some of objectives. In order to achieve gains like win-partial win and partial win-partial win, the parties are required to compromise and ensure mutual objectives one another.

“Communication” occupies the fifth position. A supply chain is generally associated with inter-organizational communications. Communication is crucial in construction management since information share among construction participants will lead to minimize errors, reduce time delays and reworks [27]. However, under traditional contracts, the parties tend to be secretive with their information. The lack of open communication can affect the formation of long-term relationships between the parties. The open

exchange of information, effective communication facilitates the exchange of ideas and visions, which can result in fewer misunderstandings and stimulate mutual trust [7]. Improved communication is a key organizational requirement for better performance of each participant in the CSC integration and construction process management to achieve a win-win outcome [27].

5 CONCLUSIONS

This paper performed a questionnaire survey that was to identify and discover important factors affecting supply chain relationships in construction. The 12 key factors affecting the supply chain relationships in construction were identified through a comprehensive review of the literature on two resources including (1) the success factors for partnering and (2) the factors that lead to the traditional adversarial relationship or unsuccessful partnering to identify factors affecting CSC relationships. The findings showed that “working relationship”, “top management support”, “trust”, “business attitude”, and “communication” are the five most influential factors.

The study can be considered as a valuable additional contribution to the body of knowledge relating to the CSCM. The findings could help practitioners to have an insight into the CSCM and obtain success in managing the CSCs.

Despite the achievement of the objectives, there is a limitation to this study. The study was conducted in context of Vietnam, therefore the findings may not be generalized to other geographical locations. Besides, the self-reported method of data collection has been used and thus there may be a possibility of bias playing a role in the final outcome of the study. Future research can apply multiple methods to obtain data and collect data from different geographical locations to overcome this limitation.

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KHÁM PHÁ CÁC YẾU TỐ ẢNH HƯỞNG ĐẾN CÁC MỐI QUAN HỆ TRONG CHUỖI CUNG ỨNG XÂY DỰNG

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Tóm tắt. Quản lý các mối quan hệ kinh doanh giữa các bên liên quan trong chuỗi cung ứng xây dựng là yếu tố thiết yếu của việc quản lý chuỗi cung ứng xây dựng. Vì vậy, để đạt được sự thành công trong quản lý chuỗi cung ứng xây dựng, các mối quan hệ giữa các bên cần phải được quan tâm. Nghiên cứu này nhằm xác định và khám phá các yếu tố quan trọng ảnh hưởng đến các mối quan hệ giữa các bên trong chuỗi cung ứng xây dựng. Nghiên cứu này đã xác định được 12 yếu tố chính ảnh hưởng đến mối quan hệ giữa các bên và xếp hạng chúng theo mức độ ảnh hưởng. Kết quả nghiên cứu cho thấy “mối quan hệ làm

việc giữa các bên”, “sự ủng hộ của ban lãnh đạo cấp cao”, “sự tin cậy”, “thái độ kinh doanh”, “sự trao đổi thông tin” là 5 yếu tố ảnh hưởng nhất. Nghiên cứu này được xem là một đóng góp có giá trị vào khối kiến thức liên quan đến quản lý chuỗi cung ứng trong xây dựng. Những phát hiện của nghiên cứu có thể giúp các bên liên quan hiểu rõ hơn về quản lý chuỗi cung ứng xây dựng và đạt được thành công trong việc quản lý nó.

Từ khóa. quản lý chuỗi cung ứng, chuỗi cung ứng xây dựng, các mối quan hệ chuỗi cung ứng, các mối quan hệ chuỗi cung ứng xây dựng.

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