

A Critical Review of Fragmentation Issues in the Construction Industry

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Abstract: The construction industry has generally been regarded as one of the least productive sectors worldwide, with issues ranging from the more common problems, such as delays and cost overruns, to more inter-connected and complex, such as conflicts, safety, client satisfaction, quality, value for money and many more. These poor performances have been closely attributed to the fragmentation that surrounds construction industry practices, whereby construction processes often take place in a sequential manner, and parties typically work in isolation with minimal interfaces between them. This fragmented scenario has ensued the industry as unable to perform efficiently and as being synonymous with problems. This paper therefore aims to critically review past research and literatures towards identifying the fragmentation issues that have been surrounding the construction industry worldwide. The result: 46 factors were compiled from 27 sources, thus indicating that fragmentation is indeed a significant and universal problem within the construction industry. The findings in this paper is expected to provide a platform for effective solutions to be strategized in future towards improving productivity rates in construction.

Keywords: Construction Industry, Critical Review, Fragmentation, Communication, Projects.

1.0 Introduction

Fragmentation has been commonly cited in the construction industry, worldwide, which according to Abadi (2005), is prevalent in both internal and external aspects of the supply chain. The author described internal fragmentation as collaborative issues between the many alliances involved in projects, such as the clients and consultants; while at external level, organizations such as the local authority which do not have a direct contractual relationship with project teams but plays an important role towards proper completion of projects, should be considered.

Fragmentation is a common descriptor of traditional practices (Egbuomwan & Anumba, 1998; Egan, 2002; Abadi, 2005) where construction processes often take place separately and in a sequential manner, while contractors and designers generally work in isolation and therefore lack interface between themselves (Nawi et al., 2014a). Furthermore, the lack of continuity in project team setups (Dubois & Gadde, 2000) means that a new learning curve is almost always forced to take place, thus further impacting on efficiency levels (Egan, 1998).

As a result, the fragmented traditional approach has been severely criticized due to it being the most complicated, inefficient (Rowlinson, 1999) as well as being very poor in terms of offering optimum time performance for the client (Masterman, 1992; Chang & Ive, 2002). Its effect contributes to risk problems such as inadequate design (Yates, 2002), dimension contradictions of plan and section drawings (Ogunlana et al., 1996) and also being prone to opportunism (Scott, 2001) while during the construction phase, inefficiencies could occur in form of increased project complexity, rework and poor time and cost performance (Egbuomwan & Anumba, 1998). These fragmented scenarios inherently connected strongly to the below par performance of the industry (Egan, 1998) and other problematic features such as poor productivity, reduced value, low satisfaction for the client (Latham, 1994). In fact, Xue et al. (2005) held fragmentation as the main culprit for most of the industry's performance-related problems.

This paper will therefore shed light into fragmentation issues surrounding the construction industry worldwide based on a critical review of past research and literatures. Past studies that highlight fragmentation of the industry are analyzed, extracted and presented towards providing a clearer picture on the issues which is hoped to provide a platform for effective solutions in future. With fragmentation being a major obstruction for the industry to improve deliveries, it is therefore important that this matter is properly scrutinized, which is the ultimate aim of this paper.

2.0 Project Fragmentation

The construction industry has generally been attributed as one of the least productive sectors worldwide with problems ranging from the common problems such as delays and cost overruns to other inter-connected issues such as conflicts, poor safety, poor satisfaction and many more. These unsatisfying performances have been closely linked to its fragmented nature (Latham 1994; Egan, 1998) and poor management (Munns & Bjeirmi, 1996) which has been strongly linked to the inefficient conventional practices thus; it has been very hard for the industry meet expectations in terms of improvement, innovation, completion time, unburst costs, to reach quality standards, productivity and satisfaction (Latham, 1994; Egan, 1998; Chan et al., 2003). Fragmentation, has been regarded by Xue et al. (2005) as the culprit of a vast majority of the industry's performance-related problems; and is a major obstruction to the uptake of Industrialized Building System (IBS) in Malaysia (Nawi et al., 2014a) despite it being introduced since the 1960's. Traditional system is synonymous with fragmentation (Abadi, 2005) and construction processes are also often treated as separate and sequential procedures (Nawi et al., 2014). Contractors are not typically involved early in projects (Scott, 2001), and they also lack interface with designers (Nawi et al., 2014a).

According to Morledge et al. (2009), a number of idiosyncratic characteristics of the construction industry, such as being one of a kind, passive and diversified, which relates back to its disjointed physiognomies, are to be blamed for the poor performances of the industry. These has led to the domination of subcontracting exercises which draws back to the scenario

of the industry that triggers the sense of insecurity among main contractors in term of maintaining repeat jobs while also delivering other project prerequisites (Cox & Townsend, 1998). As a result, there is a higher congestion in terms of project entities involved in projects which makes coordination even tougher therefore worsening the fragmentation scenario (Mehdi Riazi, 2014) and consequently give rise to formation of non-functional project supply chains (Love et al., 1999). On top of that, the temporary and ever-changing nature of project supply chains from project to projects (Dubois & Gadde, 2000) forces participants to engage in new learning curves (Egan, 1998) thus further contributing to poor performances of the industry. When fragmentation worsens, it leads to emergence of multi-tiered lower level supply chains (i.e. sub-contractor and supplier) competing on minor work packages (Mehdi Riazi, 2014) thus may lead to opportunistic intentions and risk transferring culture among parties towards minimizing their own risks (Morledge et al., 2009) thereby triggering adversarial relationships and poor trust among project teams.

Construction projects are known to be one-of-a-kind and are very different than other industries that typically have a controlled environment. In construction, no projects are the same even if they are of the same type since factors such as locality, economy and policies highly affect the variables involved. Granting jobs as well as allotting necessary resources to execute them has lots to do with the physiognomies of projects thus, the needs in different projects can vary a lot, for instance, material and expertise requirements between public buildings and military bases can contrast significantly since both almost does not share any similarities in term of their characteristics. On top of that, with the emergence of more innovative construction methods in recent times, further adds to the complexity of its supply chain environment and therefore makes effective coordination even more challenging. Considering that there are numerous parties involved in and; that the organizational culture and performance is solidly connected (Wood & Ellis, 2005), collaboration of all project parties is vital for project success thus; it concern that should the disjointed conventional practices be continually practiced, that the construction industry worldwide may never get to fully enjoy the great benefits of cooperative and team-oriented approaches on managing construction projects.

3.0 Fragmentation Issues in Construction

Many problems of the construction industry have a strong connection with its fragmented nature (see Xue et al., 2005). A study by Dulaimi et al. (2002) also highlighted that fragmentation and segregation in the designing and construction phase as the leading obstruction from investment and development improvement. It is believed that the construction industry's characteristics itself which are special, inert and diversified, that resulted in the fragmentation effect (Morledge et al., 2009). Not only that, the construction product's characteristics also determine its structure (Hillebrandt, 2000; Orange et al., 2005) whereby many products have been characterized to be highly dependent upon the weather, location and the client (Hartmann & Caerteling, 2005; Langford & Male, 2001). In general, the fragmented nature of construction industry relates to the lacks of coordination, trust and

emphasis on the client objectives. The absence of proper setting to holistically discuss rising issues (Alashwal et al., 2011; Pringle, 2012) further complicates the situation therefore making the industry a rather wasteful and inefficient atmosphere.

Issues relating to fragmentation such as the professionals' isolation, lack of design & construction coordination, and construction process being executed in sequential conduct (Evbuomwan & Anumba, 1998; Abadi, 2005; Egan, 2002, Nawi et al., 2014b; Nawi et al., 2014c) have been seen to be caused by the traditional construction practice. Other than that, Latham (1994) emphasized that parties involved in the traditional construction process normally work separately thus causing the results to be inefficient. Moreover, the construction processes often took place separately and in sequential manner while the contractors and designers generally work in isolation and therefore lack interface between themselves (Nawi et al., 2014a). Product specifications and plans, designed to order project, heavy and projects that use components which were manufactured elsewhere may also be the criteria that could lead to fragmentation (Hillebrandt, 2000; Lange & Mills, 1979).

According to Forgues et al. (2009), fragmentation occurs as a result of the lack repetition in the design phase, lack of constraints of the subsequent process acknowledgment, and leadership or accountability absence. The vast number of isolated cooperating companies and the iteration of construction design are also used to determine the construction industry structure (Hillebrandt, 2000). Moreover, issues or negative impact on the quality of the construction design process and outcome may be due to the non-collaboration and coordination between parties involved (Dulaimi et al., 2002). The temporary nature of construction projects with the involvement of multi-disciplinary entities and numerous stakeholders throughout its life cycle (Dave & Koskela, 2009) combined with the impromptu affiliation of all participants leads to fragmentation (Dainty et al., 2005). Other than that, the iteration of design and construction process, lack of coordinating and integrating between all relating players, poor communications are all the associated factors that makes project natures to be fragmented (Love et al., 2004; Xue et al., 2005).

Communication in construction industry have been identified as a complex issue since it consists of many fragmented parties, long life cycle period and multiple organization structure (Tai et al., (2009). Poor communication is one of the major issues in construction industry (Mohamad, 1999) mostly due to the construction industry fragmented nature during design phase and this is made worse by the linguistic disparities or the dialectal cultures itself (Ngowi, 2000). In fact, ineffective communication between entities assigned for the design tasks of projects have been regarded as a major cause the projects' failure to meet client's expectations (Konchar & Sanvido, 1998; Hartman, 2000). When a project does not meet the owner's expectations there will be possibility for the consultants to redesign which then cause project completion delay (Nawi et al., 2014b). Generally, issues related to communication surfaces during the contractor-subcontractor-architect design interfaces (Muya et al. 1999) due to the limited flow of vital information between parties related. Even the main contractor-subcontractor-specialists communication were seen to be extremely low especially during

design phase (Konchar & Sanvido, 1998). Construction industry players consists of geographically distributed team members and the lack of common language act as major problems source for construction project communication (Karim Jallow et al., 2014). A successful communication is when all cross-disciplines are able to interact with each other and allows all parties to be aware whenever there is change in the project (Newton, 1995). However, project verdicts are seldom made systematically and instead almost always adopts the adhoc approach (Mohamad, 1999) thus it can lead to two (2) problems according to Agapiou et al. (1998) which is firstly, purchasing materials in an ad-hoc manner can affect interruption and delay to the schedule and secondly, large quantity material purchasing without thorough consideration requirement may cause potential wastage and inventory issues especially if the site has an inventory management or scarcity in space issue.

Fragmentation is strongly linked to traditional procurement. It has been linked with numerous downside and inefficiencies (see Abadi, 2005; Dainty et al., 2001; Rowlinson, 1999; Egan, 1998; Anumba et al., 1997; Orr & McKenzie, 1992; Russell et al., 1994; Yates, 2002; Ogunlana et al., 1996; Scott, 2001) thus the construction industry has been criticized as lacking continuousness and having poor retorts to fluctuations of delivery processes (Baiden et al., 2006). This therefore hinders the effective team formation which will lead to project delivery process inefficiency (Jha, & Iyer, 2006; Love et al., 2004; Parda, 1996; Dainty et al., 2001; Gunasekaran & Love, 1998; Latham, 1994) in form of increased project complexity, rework and poor time and cost performance (Evbuomwan & Anumba, 1998). Furthermore, the lack continuity in project team setups (Dubois & Gadde, 2000) means that a new learning curve is almost always forced to take place, thus further impact on efficiency levels (Egan, 1998). As a result, the fragmented traditional approach has been severely criticized due to it being the most complicated, inefficient (Rowlinson, 1999) as well as the worst time-effective choice for the client (Masterman, 1992; Chang & Ive, 2002). Other negative side effects of fragmentation include that it could possibly lead to projects suffering from inconsistencies from aspects of performance, efficiency, design, mistakes and omissions (Anumba et al., 2002; Baiden et al., 2006).

Fragmentation and project-based contracts in construction industry lacks networking closures and have many structural holes (van der Vlies & Maas, 2009) while the traditional design and build practices obstructs efficient knowledge management thus hindering the constructors and other professionals to contribute to design decisions (Song et al., 2006; Egan, 1998) thus losing on opportunities to maximize erudition, innovation and new knowledge (Egbu, 2006; Den Hertog & Brouwer, 2001). There will cause difficulties to achieve effective knowledge transfer between the different contributors to the design and construction of a project due to gaps created by fragmentation (Dulaimi et al., 2002). Design partners within project alliances for example, unless otherwise stated by the client, are not allowed to participate in the design phase or to influence the design. This is due to the nature of conventional exercises that regards all parties as distinct entities thus it lacks a thorough administration and organisation in the procurement process (Tenah, 2001). Other than that, failure of the design team to take into consideration on the contractor's method statement during the design phase may

consequently lead to other issues when works start on site such as scheduling issues, delays and disputes in construction process (Arditi et al., 2002). Traditional procurement fragmentation also affects some other issues, for instance –(a) insufficient identification, arranging, prioritizing and implementing client needs; (b) possibilities of late and pricey design adjustments and irrelevant claims; and (c) classification of design procedure with an inflexible sequential activity (Anumba et al., 2002; Evbuomwan & Anumba, 1998; Clarke, 1999; Kong & Gray, 2006)

Latham (1994) and Nelson (2004) stated that during the preliminary stages of projects, there is a need for expert contributions from professionals such as from aspects of mechanical, engineering and facility management. This is important to ensure that all client want and needs are properly delivered with the utmost efficiency in term of cost, time and quality, which in this case it is very important that all parties in the project are on the same page in term of the deliverables they are going to produce. For example, during the design and construction stage the goal of designers may be to build a building that reflects their philosophical yet functional however the builders will want to build a reasonable and limited risked building which clearly shows the diversification of goals between them (Mendelsohn, 1998; Nawi et al., 2014b). These diversification practice of goals that are typically as a result of the traditional design and construction working culture may lead to misinterpretations or assumptions (Gardiner & Simmons, 1998) which will consequently lead to conflict, discrepancies and misalliances among the parties involved in a project (Hegazy et al., 2001). Further skirmish may also surface as a result of this scenario due to the tendency of parties to pass risks to others (Nawi et al., 2014b).

Table 1 summarizes the fragmentation issues in construction projects from past research and literatures while Table 2 provides references to the remarks used to indicate references that represent each fragmentation issue.

4.0 Methodology

Towards establishing the fragmentation issues that have been surrounding the construction industry, a critical review was conducted on the existing research and literatures worldwide from the past few decades. Search for keywords, statements and elements that indicate fragmentation or issues caused by fragmentation of the industry were extracted and compared against those found in other literatures. Issues that were similar to each other, even if were sentenced differently, were combined and indicated in Table 1 as being identified from a number of sources. In the end, a total of twenty-seven (27) sources were reviewed and tabled out for ease of viewing, analysis and interpretation.

5.0 Discussion, Conclusion and Recommendation

This paper presents the findings of a critical review on fragmentation issues surrounding the construction industry based on past research and literatures. In overall, a total of 46 fragmentation issues were compiled from 27 sources which highlights the seriousness of

fragmentation problem within the construction industry worldwide - evident from the vast number of performance-related problems also reported in other research worldwide i.e. delays, cost overrun, low satisfaction, etc. – all of which are negative outcomes resulted from the fragmented environment of the industry. Based on Table 1, it is also evident that some issues are more dominant than others based on the number of times they were mentioned in the literature. Out of the 46 issues that were identified, “isolation of project professionals – geographically distributed at different locations” was the mostly mentioned factors - by six (6) out of twenty-seven (27) sources while, “the sequential nature of construction process execution” came out the second most dominant issue, mentioned in four (4) sources. Coming the third highest was “confrontational culture between project parties” being mentioned three (3) times; while the rest on the issues were either mentioned once or twice. The domination of these three (3) fragmentation issues very much expected since the term “fragmentation” itself refers to “separation”, which is the opposite to integration or amalgamation. When parties are isolated from each other, especially from the geographical context, it makes integration even harder since there will be numerous barriers to fast and effective communication, coordination and collaboration. The sequential nature of operations on the other hand makes things worse since the various inter-connected information and knowledge that are available within the supply chain need to be properly communicated, transferred and integrated to produce the best design, reduce reworks, reduce errors, avoid missed information, prepare a good cost plan and many more. However, when an activity can only start after the other completes eliminates the integration between the parties. In the end, the result of poor interactions leads to confrontational behaviors due to the lack of opportunity to build up trust, understanding and chemistry between the parties involved. It is therefore recommended that the industry practitioners should be further exposed, educated and trained on new and emerging working philosophies such as Supply Chain Management (SCM). This is based on a statement by Riazi & Nawi (2018) that “*SCM’s philosophy opposes the fragmented working environment and promotes integration as an integral aspect of a successful work environment* “. In fact, SCM has also been highly promoted by two famous UK Government Funded Reports namely the Latham Report (1994) and Egan Report (1998) as well as other researchers worldwide; and has been proven effective on project performances in few applications

Table 1: Fragmentation Issues in Construction Projects from Past Literatures

No	Fragmentation Issues	References																										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1	Projects are not client focused	█																										
2	Efficiency of construction industry		█																									
3	Adequacy of holistic discussion forums for projects (e.g. Value Management, Risk Management, etc.)			█																								
4	Lack of repetition in project designs (one-off design)				█																							
5	Product used in projects are client-dependent					█																						
6	Product used in projects are location-dependent						█																					
7	Product used in projects are weather-influenced							█																				
8	Duration of project life-cycle affects effectiveness of communication								█																			
9	Too many project entities / parties throughout project lifecycle									█																		
10	Temporary nature of parties involved in projects										█																	
11	Isolation of project professionals - geographically distributed at different locations											█																
12	Separation of project site and designer location												█															
13	Language difference													█														
14	Effectiveness of communicating culture among project parties														█													
15	Effectiveness of contractor-subcontractor-specialist communication throughout project life-cycle															█												
16	Effectiveness of contractor-subcontractor-specialist communication during design phase																█											
17	Effectiveness of communication between contractor-subcontractor-architect during design phase																	█										
18	Effectiveness of communication between contractor-subcontractor-architect throughout project lifecycle																		█									
19	Sufficiency of information flow between project parties																											
20	Sequential nature of construction process execution																											
21	Sufficiency of consideration of constraint within subsequent phases																											
22	Segregation of design and construction phase																											
23	Sufficiency of leadership																											
24	Sufficiency of accountability																											
25	Sufficiency of coordination between design and construction processes																											
26	Sufficiency of collaboration between project parties																											
27	Sufficiency of coordination between project parties																											
28	Ad-hoc nature of decision making in projects																											
29	Sufficiency of consideration on material purchasing																											
30	Ad-hoc manner of material purchasing																											
31	Sufficiency of consideration on material purchasing																											
32	Sufficiency of feedback loops between the design and construction																											
33	Extent of integration between professionals team during design and construction phase																											
34	Sufficiency of interaction between contractor and designer																											
35	Understanding issues between project team members																											
36	Assumption issues between project team members																											
37	Confrontational culture between project parties																											
38	Oppportunistic behaviour																											
39	Empowerment of learning and innovation solutions																											
40	Empowerment of design and construction knowledge management																											
41	Existence of overall management in the procurement process																											
42	Existence of overall coordination in the procurement process																											
43	Appropriateness of communication on design changes among design team members																											
44	Client's understanding on construction procurement - knowledge on which method / set-up produce best result																											
45	Risk accountability among project participants																											
46	Different project goal / objective among designer and builder																											

Table 2: References for Number Remarks in Table 1

References	Remarks	References	Remarks
Alashwal et al. (2011)	1	Xue et al. (2005)	15
Dave & Koskela (2009)	2	Alashwal & Hamzah (2014)	16
Forgues et al. (2009)	3	Dulaimi et al. (2002)	17
Hartmann & Caerteling (2005)	4	Mohammad (1999)	18
Tai et al. (2009)	5	Agapiou et al. (1998)	19
Dainty et al. (2005)	6	Egan (1998)	20
Evbuomwan & Anumba (1998)	7	Gardiner & Simmons (1998)	21
Abadi (2005)	8	Arditi et al. (2002)	22
Nawi et al. (2014b)	9	Kong & Gray (2006)	23
Nawi et al. (2014a)	10	Den Hertog & Brouwer (2001)	24
Hillebrandt (2000)	11	Song et al. (2006)	25
Ngowi (2000)	12	Tenah (2001)	26
Konchar & Sanvido (1998)	13	Hartman (2000)	27
Muya et al. (1999)	14		

(see Brady et al., 2006; Potts, 2009; Building Magazine, 2004; p.40). Nevertheless, SCM requires a major shift in mindset and working mentality of the industry players which suggests that its uptake should be championed by parties that can highly influence the construction industry of particular nations (e.g. public sector) – thus encouraging the other

supply chains of the industry to follow suit. With proven successes via few targeted implementations, there is a great optimism that SCM uptakes could lead to improved level of team-oriented working culture thereby curing fragmentation scenario of the industry.

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7.0 References

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