

SECM/15/029

# The significance of Building Information Modelling to the Quantity Surveying practices in the UAE Construction Industry

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Abstract: Quantity surveying is a significant discipline in the construction industry. Building Information Modelling (BIM) was defined at early stages as the development of Computer Aided Design (CAD). BIM has been developed and it has the potential to revolutionise construction process in the way how buildings are designed, analysed, constructed and managed. Several disciplines including quantity surveying profession are being extensively impacted by the emergence of BIM. The quantity surveyors' roles in construction include a wide range of services. BIM offers numerous advantages to the quantity surveying practices. However, BIM adoption level in quantity surveying practice is comparatively less due to some of its current limitations and challenges. The aim of this paper is to investigate the effectiveness of BIM adoption in quantity surveying practices in the UAE. The secondary data was collected through a critical literature review and whilst empirical data was collected through semi-structured interview and online questionnaire survey among the quantity surveyors in the UAE. It is highly recommended that the implementation of BIM in quantity surveying practices in the UAE is beneficial and would generate great opportunities for the development of the construction industry. It is also suggested that the uptake of BIM is more effective to survive in the competitive construction market.

Keywords: BIM, Quantity Surveying Practices, UAE Construction Industry

#### 1. Introduction

The construction industry, unlike other industries, acknowledged is widely for its special characteristic which is unique. Meantime it has been criticised for conservative [13]. Another feature of the construction industry is information intensive due to the construction of complexity buildings [4]. The construction industry plays a major role in driving economies of a country. Not only it contributes to the country's economy but an innovative and efficient construction industry causes to create a stable global economy in macro level [17]. However, the industry has been blamed for notoriously conventional and for relatively slow adoption of changes. In particular, data transfer among project stakeholders is time consuming [6]. The construction industry has remained slow in the adoption of innovative technologies although it has been proved with strong evidence that the information technology (IT) has a positive impact in the project performance [14]. New technologies provide several benefits to the industry by increasing the opportunities. Technology in a simple form refers to improvement in soft and hard methodologies [13]. IT applications provide the platform for the

improvements in design and project monitoring. This has lowered the project cost and improved accuracy, speed and safety. Consequently, more benefits such as solution for uncertainties in a construction project and dispute resolution have been expected from an advanced form of IT [22].

Quantity surveying is a significant discipline in the construction industry. Measurement or quantification is a basic capability expected from the quantity surveyor. Quantity surveyors largely involve in quantities take-off and preparation of bill of quantities [1]. Measurement is derived from coordinate data which is usually in the form of design or construction drawings. The invention of computer aided drawings (CAD) has impacted the way in which the quantities are taken off and the bills of quantities are prepared. The bills of quantities are prepared using the data generated from CAD. Whilst this concept has been realised in the research environment the challenges and the opportunities have been started to be addressed. This led to cast the base for building information modelling (BIM). Therefore, BIM was defined at early stages as the development of CAD [13]. BIM has been developed and it has the potential to revolutionise several disciplines including quantity surveying profession considerably.

# 1.1 BIM Definition

The basic concept of building information modelling is developed and described by many authors. BIM concept was described elaborately in the report written by Thompson & Miner in 2007. When all relevant data for an entire project are stored in a central point by various disciplines in order to enable all the stakeholders to exchange their engineering and business knowledge including time and cost parameters, then the project could be managed and executed in a virtual environment [21]. This process allows many stakeholders to be involved at an early stage and improved coordination by real time collaboration and therefore, the project can be benefitted in several ways. The resulting model serves as a source of data which can be extracted and analysed according to the requirements [2].

BIM is defined in a simple way as "the digital representation of the building process to facilitate exchange and interoperability of information in digital format" [6]. BIM is not only a digital representation but it also involves with the creation of virtual models of buildings and assists in identifying all possible construction related problems and implications other through simulation at an early stage before physical construction commences [7]. BIM is defined in an effective way as the process of producing digital database containing all relevant information for lifecycle of a project and is expressed in an interoperable way to create, engineer, estimate, illustrate and construct a project [19].

In another short form and multi-disciplinary perspective, BIM is defined as a 'collaborative project oriented method' which produces many building models and allows all the project stakeholders to communicate and exchange data during modelling process [20]. The communication and data exchange among stakeholders occur at all the stages of project lifecycle and therefore, the project could be possibly free from many types of design based defects. This process also eliminates unnecessary variations which occur during construction phase due to design failures. The application of BIM is not limited only for design and construction phase of a project but it assists in facility management also [15].

BIM deals with all required information related to the project in terms of its design, planning, construction and operation [3]. BIM extends its information even to cover the buildings' physical and functional characteristics in the operation phase [11]. Physical characteristics include all the properties information such as function, shape, dimension and material [10].

# **1.2 Different levels of BIM**

The gradual development of Building Information Modelling is demonstrated in a three dimensional digital representation. Level-1 deals with traditional two dimensional design process of drawings but level-2 enhances the design into 3D modelling. In contrast to 2D drawings where sets of lines and areas are illustrated through soft and hard intelligent features, data related to each object are stored by means of BIM in level-2. BIM is matured in level-2 where various professionals particularly designers involve collaboratively and they are able to model real life situations before construction commences [13]. Level-3 is considered to be more advance with the integration of 4D and 5D which are time and cost parameters respectively. Level-3 represents the most complex BIM with fully integration of all relevant information for the whole lifecycle of the project [8]. Figure 1.1 displays the maturity diagram of BIM at different levels.

This paper mainly deals with two variables which are BIM and quantity surveying practices in United Arab Emirates (UAE). The research seeks to correlate between these two variables.



Figure 1.1: BIM maturity levels (Department for Business Innovation & Skills- BIS, 2011)

#### **1.3 Problem statement**

BIM provides substantial benefits to any construction project and supports overall project processes. As a result, all the stakeholders are benefitted through improved project performances. Similarly, BIM offers numerous advantages to the quantity surveying practices as well [16]. However, BIM adoption level in quantity surveying practice is comparatively less due to some of its challenges [23].

Legal issues and cultural issues are well known challenges in BIM application [12]. UAE is not exempted from these challenges. Copyrights of design and data, ownership, sharing of responsibilities among project participants are few examples of legal issues [2]. Human and cultural issues are considered as largest barriers for BIM adoption. Professionals do not show willingness to change from traditional practice to new procedures mostly because they feel comfortable with their present roles [25]. As far as BIM application is concerned it deals with substantial amount of changes to the traditional quantity surveying practices [4]. Therefore, these concerns have caused the quantity surveying professional reluctance to change their current roles to BIM enabled practices.

Besides the challenges as described above, there is insufficient evidence to show the benefits of BIM application in terms of financial aspects. This applies in BIM enabled quantity surveying practices too. Quantity surveyors are behind in adoption of BIM into their practices not only due to the above mentioned challenges but also due to lack of awareness and being unsure of its application [23].

Based on all the facts and arguments stated above, it triggers a need for the research to know whether the adoption of BIM in quantity surveying practices is effective.

# 1.4 Aim of the research

The aim of the research is "to explore the effectiveness of Building Information Modelling in Quantity Surveying practices in the UAE Construction Industry".

### 1.4 Research objectives

The following objectives are established in order to achieve the aim within the allocated time frame of the research study:

- 1. To critically review on what "Building Information Modelling" means in the construction sector.
- 2. To review on quantity surveying practices in UAE construction industry.
- 3. To investigate the awareness of Building Information Modelling among quantity surveyors in the construction sector in UAE.
- 4. To explore the benefits of Building Information Modelling in quantity surveying practices in UAE.
- 5. To identify the challenges of Building Information Modelling in quantity surveying practices in UAE.
- 6. To make recommendations to the Quantity Surveyors on the usage of Building Information Modelling in UAE.

# 2. Research methodology

The aim was established to reflect the working title in a simple and narrowed area of work. Initially the aim was developed as a research question and converted into a conjectural statement of the relationship between BIM and quantity surveying practices. The established aim attempts to discover some truths which are perceived by many quantity surveyors. BIM is perceived to be more beneficial in quantity surveying practices. The topic area relates to the positivist theoretical perspective and the research is designed as a deductive approach. The study seeks to explore information regarding BIM in relation with quantity surveying practices hence, the research falls under the category of exploratory studies. The data required for the research was medium level of rigour. Based on these categorizations survey approach was selected as the most suitable research strategy for this study. There are two subdivisions of survey strategy which are analytical and descriptive surveys. Since the research deals with deductive approach with an emphasis on reliability of systematically collected data for the correct generalization of results through statistical control of variables, analytical survey is chosen. Further, the sample size is relatively big, geographically dispersed and it deals with relationship between two variables only thus, it justifies the selection of analytical survey [5].

The sampling method used in this study, which is the selection of precise and random samples in order to standardize error free data, shows the strengths of survey strategy over the other competing strategy like case study where generalizability of the results is limited to only certain principles.

As far as research techniques are concerned questionnaire survey method is chosen for this research study. Questionnaire survey was constructed to investigate the correlation levels between BIM and quantity surveying practices. Focussed interview was also designed only to seek expert opinion but the questionnaire survey was adopted as the main technique for this research study. Structured interview approach has many advantages over the other techniques. The researcher is able to ensure the validity of data through conducting interviews personally. The researcher himself administers the questions and clarifies the doubts of interviewees at the same time. Repeatability and consistency are the other strengths of the structured interview techniques [9]. Even though interview has distinguished advantages, the questionnaire survey was selected as the technique because of the large size of representative sample which is widespread all over the country. Therefore, conducting interviews with each individual with prior appointment would consume more time or it might become impossible. Further, it is expensive too. In order to avoid errors in data large representative sample is selected for the questionnaire survey [5]. Another advantage of questionnaire survey is that the data can be

validated up to certain extent if similar questionnaires were used before to draw the similar data. Questionnaire was disseminated online in order to save time for both researcher and the participants.

# 2.1 Practical implementation of the chosen strategy

Two types of information such as secondary and empirical data were approached to acquire information for the research study, particularly BIM in quantity surveying practices. The secondary data was obtained through academic literature and related study material. Even though the secondary data offers required information about research study up to certain extent, the primary data is still required to reinforce the secondary data and to achieve research aim and objectives successfully. The primary data was collected in two ways which were semi-structured interviews as a mode of seeking expert opinion and online questionnaire survey. Five experts were selected for conducting interview. The research population is the professional quantity surveyors of all categories, who practise in UAE. The sampling frame of the research study was 600 professional quantity surveyors and the targeted representative sample was 100 quantity surveyors. Based on recent research studies carried out by both post graduate students and the university lecturers it was found that the response rate of the participants for similar studies in UAE was less and resulted in between 20% to 25% [18]. Considering this fact and risk of high volume of non-responses, 600 professional quantity surveyors were chosen as the sampling frame and at least 100 responses were expected. The quantity surveyors were divided into five categories based on the type of organizations where they were employed. The categories consisted of quantity surveyors who work for client, developer, consultant, constructor and subcontractor. The sampling frame was selected in such a way that the quantity surveyors from all of these categories were included. The purpose of this categorization and the wise selection of sampling frame were to represent the wider population properly and to generalize the survey results accurately. The categorization process also served the purpose of ensuring the relevance and validity of responses.

#### 2.1.1 Focussed interview

A focussed semi structured interviews were conducted with the pre-selected quantity surveyors

who were experts on BIM and employed within UAE. Only five experts were targeted for the interview. The purpose of conducting these interviews was to obtain professional insight about the research subject and the UAE Construction Industry. The acquired information was much useful to refine the questionnaire by eliminating simplifying. ambiguous contents and The interviewees were qualified based on their level of industry experiences and total number of projects where BIM was adopted. The expert quantity surveyors were chosen from different disciplines such as project manager, contract manager, commercial manager, cost manager and procurement manager.

### 2.1.2 Questionnaire survey

Questionnaires were disseminated online among the professional quantity surveyors from different organizations in UAE through their e-mails in order to form the second part of the primary data. The online software tool called 'surveymonkey' was used to dispense the questionnaires and to receive the responses from the respondents. The online questionnaire survey was carried out at a particular time period in order to control the extraneous variables by holding them constant that is, the research was not focussed on the implication of BIM in quantity surveying practices in different periods of time.

#### 2.2 Data collection

The data received from respondents were summarized and stored in a spread sheet for each question separately. All the information received from the respondents was stored digitally in a standardised format. All relevant ethical issues regarding the protection and maintaining the confidentiality of the data are fulfilled during data collection period. The late responses from the participants were not taken into consideration.

# 2.3 Data Analysis

Data from each question was analysed and discussed separately. Some of data were derived through combining the responses of few questions and the same data were analysed to get more insights from the research study. Both qualitative and quantitative approaches were used to analyse the data because the questions were from both types. The data for few questions were converted from qualitative to quantitative and analysed by adopting weighted average method. Statistical

measures such as mean and standard deviation were used to analyse the data. Bar charts were used for the effective comparison of the results. In addition, software tool for data analysis such as 'surveymonkey' was adopted.

#### **3.** Survey results and analysis

### 3.1 Focussed interview

The experts were approached for conducting faceto-face interview. The advantages, challenges and drivers of BIM in relation with quantity surveying practices, which were found through critical literature review. were discussed with interviewees. All the interviewees agreed that these advantages, challenges and drivers which are experienced in BIM technological advanced countries like USA and UK, are applicable in UAE too. Some advanced applications of BIM in quantity surveying practices were pointed out by interviewees, which are cost and schedule performance analysis softwares. Draft questionnaire was refined with additional information from experts. Some of literature findings and questionnaire detail were emphasized interviewees' opinions. through Without contradicting all the experts agreed that the quantity surveying practices would be benefitted by adopting BIM and strongly suggested the significance of the benefits of its adoption.

# 3.2 Questionnaire

Total of 74 responses were obtained through online questionnaire survey. Even though the target representative sample was 100 the current sample size is only 74. However, the sample comprises of all types of quantity surveyors from various organizations. Therefore, generalization of the research findings is effective. The majority of respondents are well experienced. The results show that nearly 42% of the respondents have 6 to 10 years of experience and another 42% of the participants have more than ten years of experience approximately. Therefore, total of 84% of the respondents have more than five years of valuable industry experience. As a result, the information offered by the respondents would be rich. This is a good indication that the analysis of the data obtained from respondents would provide valid and effective results.

### 3.3 Quantity surveying practices in UAE

As far as current practices of quantity surveyors in UAE are considered all types of OS roles are exercised as per the data obtained through online questionnaire survey. All quantity surveying roles such as measurement and quantification, Preliminary estimates, Feasibility studies, Cost planning, Preparation of BOQ, Advise on procurement method and contractor selection, Tender analysis, Construction contract practices, Financial management, Valuation of claims and variation, Project management, value management, Management contracting, facilities management, Development appraisal, Taxation & grants and construction dispute resolution are offered as answers by the respondents. This indicates that all types of quantity surveying roles are being practiced in UAE. It is found that basic and core practices of quantity surveyors hit high percentages but advanced competencies of quantity surveyors such as construction project management, value management, facilities management, management contracting. arbitration and other dispute resolution, insolvency, insurance, property investment funding, taxation allowances and grants, and research methodologies and techniques are practised at lower level.

Table 3.1 provides the distribution percentages of various types of quantity surveying profession in UAE. It could be noticed that the senior levels of 19% quantity surveyors contribute to approximately whereas other levels such as junior and middle range cover 81% of the total population of the quantity surveyors in UAE. However, these percentages do not match with the percentages of different competency level of quantity surveying practices as discussed earlier. For an instance, the average percentage of advanced competency level is 10% approximately whereas the senior professionals are 19% of the quantity surveying community in the UAE Construction Sector. One of the reasons is suggested that some of senior level quantity surveyors who are contract manager, commercial manager and cost manager practise core competencies of quantity surveying profession.

Table 3.1: Distribution of various types of quantity	
surveying profession	

Question - Please indicate your current profession			
Answer Options	<b>Response Percentage</b>		
Contract Manager	6.8%		
Commercial Manager	6.8%		
Cost Manager	5.5%		
Quantity Surveyor	76.7%		
Estimator	4.1%		
Total	100.0%		

# **3.4** Awareness of BIM among quantity surveyors in UAE

The awareness of BIM among the professional quantity surveyors in UAE sounds well based on the results of empirical survey conducted. Figure 3.1 illustrates the levels of understanding about BIM by quantity surveyors who practise in UAE. The respondents were given four options such as 'excellent', 'good', 'poor' and 'no idea' in order for them to show their understanding regarding BIM. Majority of the respondents, approximately 65.7%, understand BIM well however, only 31.4% of the quantity surveyors agree that the BIM is practised in their current organizations as revealed by survey results and as depicted in Figure 3.2.



Figure 3.1: Understanding about BIM among QS in UAE

It is apparent that the quantity surveyors practise BIM within their scope when their organizations adopt BIM into their projects. Accordingly, the information contained in Figure 3.2 is reasonably considered that the quantity surveyors practise BIM when their answer is 'yes' for the status of BIM practice in their firms. Although 65.7% of the professional quantity surveyors have better knowledge about BIM less than half of that population practise BIM in their organizations. The gap between the awareness and the usage is an indication that there are prevailing constraints such as client demand, lack of standard and lack of technology use in the adoption of BIM. Also this is a clear indication that the construction projects where professionals practise BIM is very less in UAE.



Figure 3.2: Respondents answers on the status of BIM practice in their organizations

### 3.5 Advantages of BIM in QS practices in UAE

Table 3.2 displays different types of BIM benefits which are experienced by the quantity surveyors.

Table 3.2: Ratings of QS related BIM applications
in UAE

BIM Benefits	Response %
3D coordination	57.14%
Visualization	57.14%
Automated quantities take-off	42.86%
Cost estimation using related software	39.29%
BOQ preparation using related software	32.14%
Computer aided construction planning	28.57%
Performance analysis using software	25.00%
Computer aided construction management	21.43%
Lifecycle costing using software	10.71%

The results show 3D coordination and visualization applications are being used by majority of the respondents whereas software for lifecycle costing is being practised comparatively very less. The finding depicts that main benefit of 5D BIM is visualization of the building because it is connected with many other benefits such as bulk checking device for manual measurement, efficient data extraction for estimating, producing schedules of quantities, rapid identification and costing of

design changes. Finally, all these benefits lead to have commercial advantage over competitors. It also explains that there is a lack of interest among practitioners in usage of BIM for its expanded applications such as lifecycle cost estimates.

# **3.6 Challenges of BIM's adoption in QS practices in UAE**

The survey results describe the respondents ranking on barriers for BIM adoption in quantity surveying practices. This shows that the lack of experience and knowledge are the most effective barriers whereas lack of confidence with automation is ranked as the least effective barrier in adoption of BIM in quantity surveying practices. The effectiveness of the barriers diminishes as the rank increases from 1 till 6. Therefore the middle which is 3.5 reflects the average (mean).

It could be identified that the lack of experience and knowledge, lack of awareness of BIM's benefits and lack of client demand are more effective obstacles which fall less than 3.5 as average rating whereas resistance to change from traditional practices, investment expenses and lack of confidence with automation are less effective barriers comparatively since they take average ratings more than 3.5. However, the hindrances such as lack of experience and knowledge, lack of awareness of BIM's benefits and lack of confidence with automation are focussed more since these factors deviate exceptionally towards either sides of effectiveness from the average (mean) compared to others. Hence, the said first two hindrances are considered as very strong barriers while the third one is very weak for the adoption of BIM in quantity surveying practices in UAE.

Lack of confidence with automation is cited by the respondents as the least obstacle. This is clearly evidenced by Dubai Mall Project which is one of the iconic projects and world largest shopping mall. The automation function used for the construction of Dubai Mall has saved over 700 man-months, which in other words the automation resulted in increase of efficiency by 86% and an overall savings of 7 Million US Dollars. Therefore, it is strongly suggested that the effect of these magnificent savings has resulted in increasing the confidence level in BIM's automation function among quantity surveyors in UAE.

# 3.7 Effectiveness of BIM's adoption in QS practices in UAE

Table 3.3 provides the ratings of quantity surveyors regarding their overall opinions in relation with BIM enabled quantity surveying practices. The listed options are the essential requirements in quantity surveying practices. Majority of the respondents agree that BIM improves these benefits to quantity surveying practices. However, considerable percentage of respondents disagree the statements that adoption of BIM would offer increased accuracy and increased reliability. In overall more than 90% of the respondents agree each of the statement in relation with the adoption of BIM. The data shows a clear and robust indication that the adoption of BIM is very beneficial to the quantity surveying practices in UAE. This statement is further supported by the data shown in Table 3.4.

Table 3.3: Rating the overall opinions of respondents regarding BIM enabled QS practices

BIM	Strongl	Agree	Dis-	Strongly
Benefits	y agree		agree	dis-agree
More cost savings in the long run	28 (44.4%)	33 (52.4%)	2 (3.2%)	0 (0.0%)
Time	28	32	1	0
savings	(45.9%)	(52.5%)	(1.6%)	(0.0%)
Increase	26	31	5	0
accuracy	(41.9%)	(50.0%)	(8.1%)	(0.0%)
Increase	25	31	5	1
reliability	(40.3%)	(50.0%)	(8.1%)	(1.6%)

According to the survey results which is tabulated in Table 3.4, approximately 97% of the quantity surveyors show their positive attitudes towards uptake of BIM in quantity surveying practices in UAE. In overall point of respondents view, implementation of BIM in quantity surveying practices in UAE is highly recommended and more effective to survive in the competitive construction market.

Table 3.4: Rating the opinions of respondents
regarding the implementation of BIM in QS
nractices

Question 15 – Would you recommend the implementation of BIM in quantity surveying practices?		
<b>Answer Options</b>	<b>Response Percentage</b>	
Yes	96.7%	
No	1.7%	
No idea	1.6%	

#### 4. Conclusions and Recommendations

The rich information acquired through the research study reflects positive attitudes of majority of the quantity surveyors in UAE, towards the benefits of BIM and its implementation regardless the small percentage of BIM's awareness level. The interviewees showed their consent on the uptake of BIM in quantity surveying practices and strongly suggested the significance of the benefits of its adoption.

Concluding all the literature collections of BIM in construction, it is examined that there is no unifying definition which covers all the aspects of BIM. As BIM continues to evolve and being developed over time, many theoretical concepts are frequently drawn from different perspectives. However, BIM can be defined including almost all of its aspects, as "the process and technology for producing, managing and sharing physical and functional data of a facility in a collaborative environment using digital representative models throughout project lifecycle processes [24]. All the data in BIM environment should be shared or exchanged in an interoperable way.

All types of quantity surveying disciplines as found in the literature are practised in UAE. However, the practised percentage differs from one to another. Basic and core competency levels of quantity surveying roles are practised from 19% to 76% approximately but advanced level practices found to be very less comparatively. Only value management role in advanced competency level is practised 34% approximately and the others fall within the range from 1% to 19% only in UAE. However, these percentages do not correspond with the distribution of various types of quantity surveyors. It is suggested as one of the reasons, that the managerial level quantity surveyors practise core level disciplines too. The awareness level of BIM among UAE quantity surveyors sounds well. The majority of the respondents show their consents regarding excellent and good understanding of BIM. Approximately 66% of the population have good knowledge about BIM whereas 31% of the quantity surveyors only practise currently. One of the reasons for the difference between these percentages can be suggested as the hindrances for uptake of BIM.

3D coordination and visualization applications of BIM are widely adopted in quantity surveying practices in UAE. Visualization leads to many other benefits of BIM in quantity surveying practices. BIM software for lifecycle cost estimate is practised comparatively very less due to lack of enthusiasm among quantity surveyors in UAE. It is found that majority of the quantity surveyors in UAE agree the significance of all the benefits which are available in the literature.

All the barriers and challenges identified in secondary data are agreed by majority of the quantity surveyors as effective hindrances for the adoption of BIM in quantity surveying practices in UAE. Lack of experience and knowledge of BIM and lack of awareness of its benefits are found to be the most effective barriers whilst lack of confidence with automation of BIM is ranked as the least obstacle. The confidence level has increased based on the benefits achieved from BIM based Dubai Mall construction. All the listed challenges are highly effective in uptake of BIM. Legal concern of copyright of BIM data is ranked as the least effective challenge as per the survey results and other recent research findings strengthen the statement. In mean time, the identified drivers and solutions are highly recommended by majority of the practitioners as important for overcoming the challenges.

By critically analysing all the above discussed survey findings and the survey results obtained for respondents' overall opinions and recommendation, it is highly recommended that the implementation of BIM in quantity surveying practices in UAE is beneficial and utilization of great opportunities. It is also suggested that the uptake of BIM is more effective to survive in the competitive construction market. All the recent research findings strengthen these recommendations.

# Acknowledgements

I would like to express my special thanks to my supervisor and express my deep sense of gratitude and sincere thanks to all who supported me in my work.

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