กรณีศึกษาการใช้แบบจำลองสารสนเทศอาคาร เพื่อประมาณการมูลค่างานก่อสร้างในส่วนงานสถาปัตยกรรมหลัก

The Case Study of Using Building Information Modeling (BIM) for Forecasting Construction Cost in Architectural Segments

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บทคัดย่อ

การวิจัยในหัวข้อ การใช้แบบจำลองสารสนเทศอาคาร เพื่อประมาณการมูลค่างานก่อสร้าง มีเป้าหมายที่จะหาแนวทางในเชิงเทคนิคในการกำหนดขั้นตอนและวิธีการสร้างแบบจำลองให้เหมาะสมต่อการประมาณการ โดยมีวัตถุประสงค์เพื่อ 1) เพื่อศึกษาแนวความคิด ปัจจัยและกรอบการการปฏิบัติที่เป็นเลิศ (Best Practice)ในการสร้างแบบจำลองที่เหมาะสม 2) เพื่อกำหนดแนวทางและขั้นตอนการสร้างแบบจำลองให้เหมาะกับการประมาณค่าก่อสร้าง 3) เพื่อเสนอตัวอย่างการจัดการรายการวัสดุจากแบบจำลอง 4) เพื่อสร้างเทคนิคและวิธีการถอดปริมาณให้เหมาะสมสำหรับการควบคุมและบริหารต้นทุน ทั้งนี้การทดลองและสร้างแบบจำลองสามมิติเป็นวิธีการที่นำมาใช้ในงานวิจัยนี้โดยใช้ซอฟแวร์ Autodesk Revit Autodesk Naviswork และ Microsoft Office Excel เป็นเครื่องมือสำหรับการทดลองแบบจำลองในหมวดงานสถาปัตยกรรม โครงสร้างบางส่วน โดยใช้ตัวอย่างมาตรฐานรูปแบบอาคารและวัสดุจากบริษัท แอล.พี.เอ็น.ดีเวลลอปเมนท์ จำกัด (มหาชน) มาเป็นตัวอย่างการพัฒนาแบบจำลองนี้ ผลการวิจัยสามารถเสนอแนวทางรวมถึงปัจจัยในการกำหนดและบริหารต้นทุนที่สนับสนุนการพัฒนาแบบจำลองดังกล่าว รวมทั้งรูปแบบการสร้างแบบจำลองสามมิติ การกำหนดรูปแบบรายการวัสดุ (Material Template) และวิธีการถอดปริมาณ (Quantity Take Off) ที่มีประสิทธิภาพในช่วงเวลาดำเนินการที่เหมาะสม ซึ่งผลงานวิจัยนี้สามารถเป็นตัวอย่างที่ดี สามารถตอบสนองและตรงตามความต้องการผู้ที่ต้องการใช้แบบจำลองในเกณฑ์ที่คล้ายเคียงกันได้ดี เพียงแต่มีขั้นตอนอยู่ที่หลักเกณฑ์ของบัญชีแสดงปริมาณวัสดุและราคา (Bill of Quantity: BOQ) แต่ละองค์กรมีวิธีจัดการ และเป้าหมายของการใช้การประการไม่เหมือนกัน จึงต้องนำงานวิจัยมาใช้เป็นตัวอย่างประยุกต์

คำสำคัญ: แบบจำลองสารสนเทศอาคาร ประมาณการมูลค่างานก่อสร้าง การบริหารต้นทุน รูปแบบรายการวัสดุ วิธีการถอดปริมาณ

Abstract

The purpose of this research is to discover the technical workflow and method of forecasting construction cost by using Building Information Modeling (BIM). The objectives are 1) to study BIM framework, modeling criteria, and relevant best practices, 2) to provide an efficient BIM guideline and workflow that imply to construction cost reliability, 3) to create example of building materials scheduling for feasible construction cost, and 4) to create a technical quantity take off (QTO) methodology for cost control which able to indicate target cost from the early project stage. This research was the modeling and experimenting methodology using in collaborative software among Autodesk Revit that initiated primary model in architectural aspect and some based building structure, and Autodesk Navisworks and Microsoft Office Excel for quantity take off procedure. Based on the sample of standardizing building design from L.P.N. Development PCL, the modeling experiment becomes a

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tangible outcome that can be proved and measured the success of result. The accomplishments of study discovered the significant factors of cost control, 3D modeling guideline and materials template, and QTO methodology. The result has shown the significant BIM aspects and criteria of forecasting construction cost in order to extract the components under given Bill of Quantity (BOQ) with efficient QTO methodology. The expected outcome of this research is to identify technical tool of building cost control and provide a guideline of BIM modeling procedure and QTO (Quantity Take Off), including table of materials summary and demonstrate how to process QTO for construction cost estimation and cost control. Nevertheless, there are certain criteria of BOQ formatting and calculation methodology, including the objective to use items in quantity take off are different in any organizations.

Key words: Building Information Modeling (BIM), Cost Control, Quantity Take Off (QTO), Material Template, Bill of Quantity (BOQ)

1. Introduction

From the past decade, the real estate and builder industrial business in Thailand was looking forward to a new tool of construction technology and cost management solution among highly competitive era. In recent years, Building Information Modeling (BIM) process has become the key establishment of cost control. BIM was defined as the process of model generating and simulating from the planning, design, construction, through operation (Azhar, 2011), while others were defining BIM as the concept of analyzed the potential problems and impacts by built the virtual physically building (Smith, 2007). The real estate developers have visualized BIM as the future of the corporate movement in the coming competitive builder market in Thailand. Many believe in using BIM for cost management and cost control for longrange sustainable business. They have aimed and adopted the advantages of BIM in scheduling all materials and replicating a design solution. Key significant targets of BIM model enable to extract all materials, for instances quantity, volume, area, and necessary fields in transition to BOQ (Bill of Quantity). The accuracy and precision of calculation that eliminate cost error and strengthen coordination system, enhances the real estate's capability in market share.

This research demonstrates the possibility and potential of using BIM as a tool for cost control in early project stage that turns up to be the great benefit of a project lifecycle, risk management, and efficient guideline for developers or investors. The research aims to provide the BIM process and workflow how to manage virtual geometry and necessary information by experimenting on targeted standardizes condominium design. The research framework has projected the variety of expertise references in cost control, lean construction, and best practice modeling standards or protocols from elsewhere in order to set up the criteria during experimental process.

1.1 Research framework

Research framework (Figure 1) demonstrates experimental procedure to find the most efficient solution in order to forecast the cost projection with Building Information Modeling as a tool. The process begins with establishment of primary target which is to identify criteria of two main procedures for cost control through BIM tools, modeling procedure and quantity take off procedure that will allow for forecasting of construction cost in the very early stage of design. It is also valuable to study various references in relevant aspects of BIM for cost control, BIM for lean construction, and including implemented international BIM standard materials which provide the opportunity to explore what have been achieved. This research an experimental methodology focusing on techniques for obtaining reliable data in efficiency of time with seamless process through given materials breakdown in BOQ as the two main procedure, modeling and quantity take off, rely on one another. The experimental research procedure will be discussed further in section 3.1 (Figure 3) that divided into modeling technique on how to assembling geometry in targeted sequence and in addition of using quantity take off (QTO) in order to evaluate on data result.

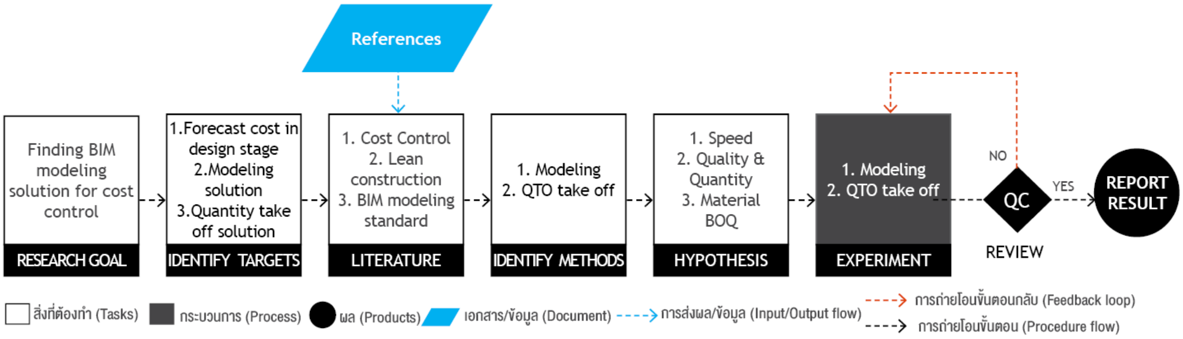

Figure 1 Research Framework Diagram

Source: Author (2018)

1.2 Literature review

Literature review is aiming to target the research framework in area of BIMs' sustainable building cost. The outline of discussion is to define the significant factors, valuables, and aspects on how BIM potentially responses to cost control, lean construction, and modeling standard.

1.2.1 BIM for Cost control

BIM's applications provide the combination of various geometry and information within building elements and components. This combination can be extracted to quantification items for further cost estimation opportunity. To achieve an ultimate goal that BIM can offers "easily compare execution time and total costs of various alternatives in terms of materials and technology, what can promote the optimization of the total cost of the investment." (Czmocha & Pekalaa, 2014, p. 212). It depends on how details in materials, finishing, and accuracy of geometry sizing response to particular project achievement. The characterizes the geometry are spatial relationships, geographic information, quantities and properties of building elements, cost estimates, material inventories, and project schedule. The model can be used to demonstrate the entire building life cycle. Therefore, BIM is a static representation of that building which contains more than one raw discipline data.

1.2.2 BIM for Lean construction

Taiichi Ohno quotes (Toyota Motor Corporation, 2018) Just In Time (JIT) of Lean Manufacturing in the international practice concept that describes the critical significance of lean production is the right product to the right time and quality. Lean in construction demonstrates the ability to plan and target in the specific outcome in a time constraint. Reducing the variation of inefficient workflow caused the reduction of time and cost so that lean production is potentially provided effective activities and flow of resources. While BIM lean approach comes along to play the important role by managing the cost plan and get into the right product, "The need for stability is balanced against the reality that the world around a project and its technology are subject to change." (Howell & Koskela, 2000, p. 9). Figure 2 describes BIM functionality interconnects to lean principles which demonstrates the combination of project quality and quantity. The concept of BIM-Lean is able to view the entire project life cycle as in production system terms as if the project were one large operation (Ningappa, 2011)

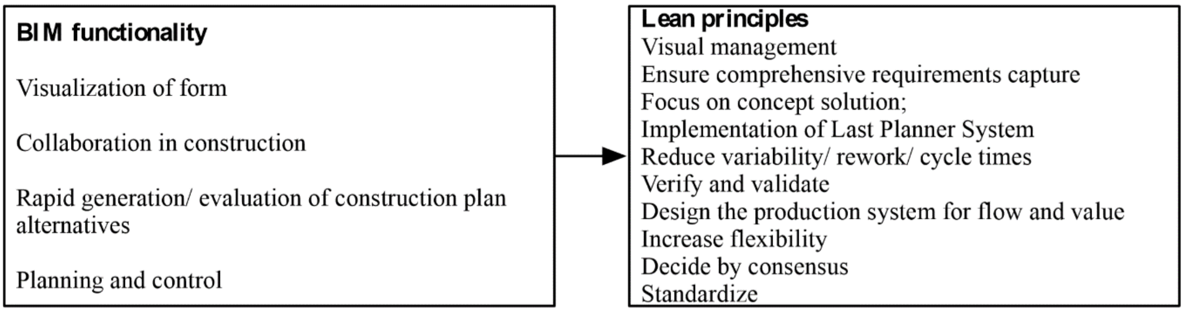

Figure 2 BIM functionalities versus Lean principles

Source: Clemente and Cachadinha (2013)

1.2.3 BIM for modeling standard

Using the variation of best practice, standard or guideline is to provide a better perception of how BIM supports to managing level of information and physicality. BCA (2012) Singapore BIM Guide demonstrates a Singapore BIM case studies and BIM management style, which provided the significant reference guide for the development of a BIM Execution Plan (BEP), which will be agreed among owner and stakeholders for the successful implementation of a BIM project. This material will support research scope and expectation of research outcome. While UK BIM national standard or AEC (UK) (2012) has initiated the process of design information production, management, and exchange which strengthened the research perspective. This material provides the benefit of research on the understanding of layering conventions as the primary concern for users of design data. BIM has shown the design needs and technology has developed, the initiative has expanded to cover other aspects of design data production and information exchange that BIM will take place.

2. Objective of research

2.1 Targets

2.1.1 To study BIM framework, modeling criteria, and relevant best practices

2.1.2 To provide an efficient BIM procedure and workflow that imply to construction cost reliability.

2.1.3 To create test model of building materials scheduling for feasible construction cost.

2.1.4 To create a technical quantity take off (QTO) methodology for cost control which able to indicate target cost before establishing the sale price.

2.2 Scope of research

This research focuses on the residential condominium type based on sample of standardize building design from L.P.N. Development PCL. The process prioritizes BIM modelling of architectural construction elements and finishing materials, with certain structural elements (e.g. column, beam, floor slab, and shear wall), while excluded superstructure (underground structural elements) and all MEP elements. This exercise also maintains L.P.N. Development PCL’s materials categorization convention from master BOQ for smooth transitioning for quantity surveyor team. The research requires a study of significant BIM aspects on cost control, lean construction, and relevant guideline materials. It requires the technical hand on experiment by understanding how building components were assembled and extracted countable elements. The research provides the modeling procedure, sequencing of quantity take off data set, and percentage of quantity ratio compare to the whole building cost.

2.3 Expected Outcome

In terms of modeling experimentation, the expected results of the project are related to achievement of targeting cost control in an early stage of the project phase. Combing of BIM in strategic point of view, efficient technical approach, as well as quantity survey management will provide the forecasting of risk management and cost planning which affects to building design, materials layering, and construction components. Design phase requires great collaborative working among designers who model building geometry, a quantity surveyor who extracts countable and uncountable items, and project owner who manages the whole master workflow. Having the sample of BIM modeling management will provide the opportunity to review the project planning and scheduling, including breakdown working plan of the design phase allow for efficient sequence planning for collaborative workflow. The research outcomes will have the potential to any organizations discover alternative BIM approach and technical demonstration in the area of the research.

3. Research methodology

3.1 Experimental research procedure

BIM is working on 2D&3D platform which integrated the visualization and construction database, therefore; the modeling and experimental research is the best methodology in order to quantify a significant test model. Figure 3 describes the experimental procedure that targets on to the efficiency of time in the speed of the repetition process and interconnect solution in quantity and quality, and as well as building materials need to be matched to targeted BOQ. Modeling procedure and QTO (quantity take off) procedure codependent as the data extract from the model match with the specific data set in the QTO process, result in cost estimation. This means one cannot be modified without the modification of another. In this case of L.P.N. Development PCL, the modification of master BOQ is kept at a minimum therefore the main hypothesis is to consider how to manage the efficient building materials and setting up to standard in the project rerun.

There are two hypotheses based on the significance on how to design the characteristic of building material components, one is the general wall, basic wall or default wall function as given, while another contains multiple layers in wall components or called a stacked wall. Once the key hypothesis has been selected that would be formulated in QTO template and extract all quantify data set for evaluation and further report result if data has passed the qualification.

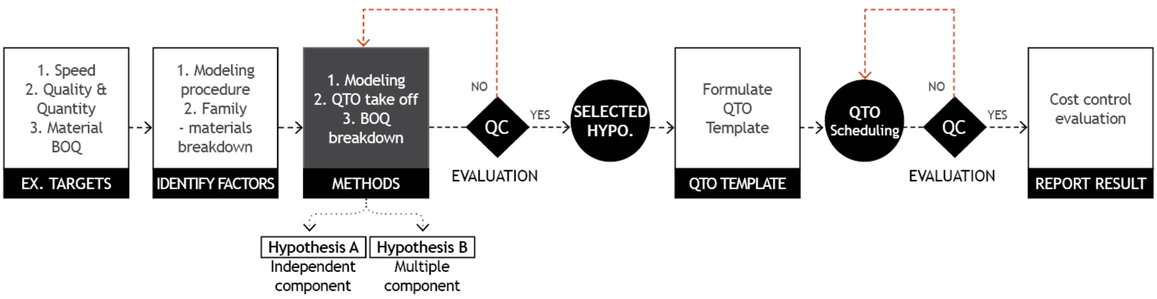

Figure 3 Experimental research procedure

Source: Author (2018)

3.2 Quantity Take off process

It is important to understand that not all elements shall be extracted from model but depends on the objectives of cost forecasting. As the target of this case is to estimate construction cost in early design stage, certain construction elements are omitted in the model, but acquire through other means of quantity take off process for the most efficient procedure. Figure 4 to describe the process of quantity take off then transit the quantity data into two main flow paths. First, there are the direct quantity take off which are countable items (e.g. walls area, doors, windows, and stairs) that can be insert to raw template for further clarification process before match to BOQ form. Second, there are number of categories in BOQ form does not present in model (Table 1) while referable to direct items (e.g. formwork, reinforce steel bar, nail, and skirting) that required a specific formulation transit to other application for categories arrangement. Final process is to combine direct and indirect calculation into BOQ template then validates all items to assure all amount are reliable. This procedure also effects tools and data transitioning involve in the project.

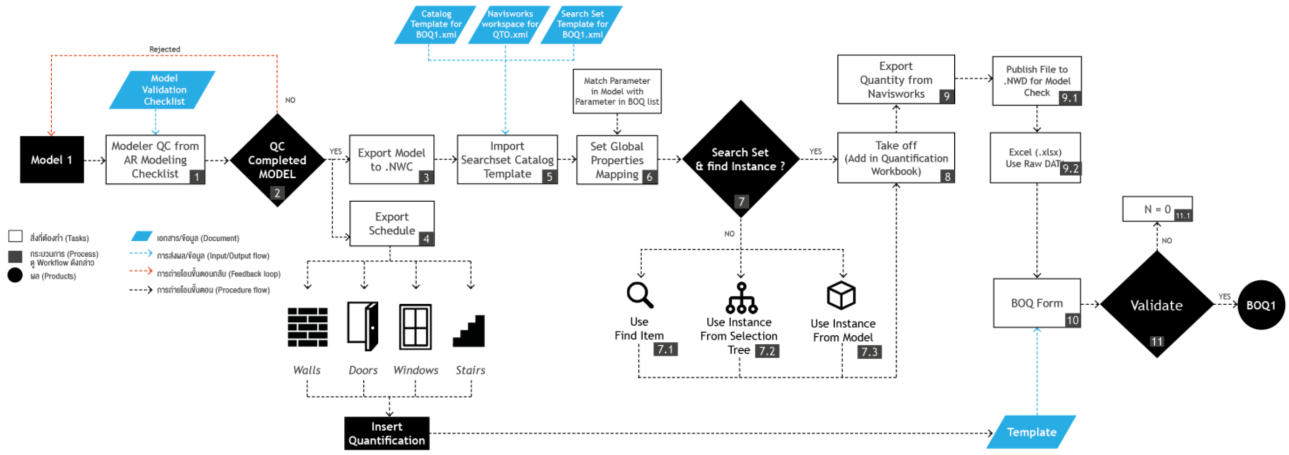

Figure 4 Quantity Take off (QTO) diagram

Source: Author (2018)

Table 1 Shows the sample of direct and indirect quantity take off in BOQ material list

Item NO.	Description of works	Description of works	Direct	Indirect	Estimate
1.00	**เตรียมงานก่อสร้าง**	**Preliminaries**			✓
2.00	**งานโครงสร้าง**	**Civil Works**			
2.01	งานดิน	Earthwork			✓
2.02	งานเสาเข็ม	Foundation Works			✓
2.03	งานคอนกรีต	Concrete Works	✓		
2.04	งานไม้แบบ	Formwork			
	ไม้แบบ (ทั่วไป/พื้นโพส)	Formwork		✓	
	ตะปู	Nail		✓	

Item NO.	Description of works	Description of works	Direct	Indirect	Estimate
2.05	งานเหล็กเสริมคอนกรีต	Reinforce Concrete			
	เหล็กเส้น	Reinforce Steel Bar		✓	
	ลวดผูกเหล็ก	Steel Binding Wire		✓	
2.06	งานระบบ Post-tensioned Slab Tendons	Post-tensioned Slab Tendons	✓		
2.07	งานโครงสร้างเหล็ก	Steel Structure			✓
2.08	งานเบ็ดเตล็ดโครงสร้าง				
	PVC Water Stop	PVC Water Stop		✓	
	ระบบป้องกันปลวดแบบระบบวางท่อ	PIPE TREATMENT SYSTEM		✓	
	งานบ่อหน่วงน้ำ, รั้วถาวร, ถนน คสล., ท่อ-บ่อพัก คสล.	RETENTION POND			✓
3.00	**งานตกแต่งผิวพื้น**	**Floor Finishing**	✓		
	พื้น (ปูกระเบื้องเซรามิค/ขัดมัน/ทาสี Epoxy)	Floor (Ceramic/Polish/Paint/Epoxy)	✓		
	บัวพื้น	Skirting		✓	
	ตัวจบพื้นลามิเนต	Infinite Floor		✓	
	ธรณีประตูห้องน้ำ	Bathroom Sill		✓	
	ธรณีกระเบื้องกั้นส่วนอาบน้ำ			✓	
	ปูนกาว/ปูนฉาบ ปูกระเบื้อง	Adhesive Plaster		✓	
	ปูนยาแนวกระเบื้อง	Tile Grout		✓	
4.00	**งานผนังและตกแต่งผิวผนัง**	**Wall Construction and finshing**			
	ผนังก่ออิฐครึ่งแผ่น	Half Brick	✓		
	ผนังก่ออิฐเต็มแผ่น	Full Brick	✓		
	ฉาบปูนเรียบ (ผนังก่ออิฐครึ่งแผ่น, เต็มแผ่น)	Wall Plastering (Half Brick, Full Brick)	✓		
	ผนังคสลสำเร็จรูป	Precast Wall	✓		
	ผนังกระเบื้อง	Ceramic Wall	✓		
	ปูนกาว/ปูนฉาบปูกระเบื้อง	Adhesive Plaster		✓	
	ผนังยิบซั่มบอร์ด	Gypsum Wall	✓		
	ฉาบปูนโครงสร้าง	Rendering		✓	
	Sealant ผนัง คสล. สำเร็จรูป	Sealant		✓	
	แต่งผิวผนัง คสล. สำเร็จรูป	Skim Coat		✓	
	กระเบื้องกันเปื้อนห้องครัว	Kitchen Tile		✓	

Item NO.	Description of works	Description of works	Direct	Indirect	Estimate
	ปูนกาว/ปูนฉาบ สำหรับผนัง	Adhesive Plaster		✓	
	ผนังทำระบบกันซึม LEX TRZ (ราคารวมงานเตรียมผิวก่อนทำระบบกันซึม)	Waterproof		✓	
	ผนังทำระบบกันซึม Lex Bond (ราคารวมงานเตรียมผิวก่อนทำระบบกันซึม)	Waterproof		✓	
5.00	**งานฝ้าเพดาน**	**Ceiling Works**			
	ฝ้า (ยิบซั่มบอร์ด ฉาบเรียบ/แต่งผิว ทาสี/แต่งผิว ไม่ทาสี/ฝ้าไม้ conwood/ฉาบปูนเรียบทาสี)	Ceiling (Gypsum Plastering / Skimming & Painting / Skimming No Painting / Conwood / Plastering & Painting)	✓		
	บัวฝ้า	Skirting Board		✓	
	ฉนวนกันความร้อน	Insulation		✓	
	Step แผ่นยิปซั่ม	Gypsum			✓
	ช่อง service	Service Opening Cover			✓
	ช่องดูดอากาศ	Exhaust			✓
6.00	**งานซุ้มหลังคา-ซุ้มตกแต่ง-แผงประดับ**	**Roof decoration**			✓
7.00	**งานประตู-หน้าต่าง**	**Doors and Windows Works**			
	ประตู-หน้าต่าง	Door & Window	✓		
	ซับวงกบ	Sub-frame		✓	
8.00	**งานสุขภัณฑ์และอุปกรณ์**	**Sanitary ware and accessories**	✓		
	ชักโครก	Water Closet	✓		
	อ่างล้างหน้า	Lavatory	✓		
	ฉากกั้นอาบน้ำ	Shower Curtain	✓		
	ราวทรงตัวเสตนเลสสำเร็จรูป(มาตรฐาน)สำหรับคนพิการ	Grabbar	✓		
	เคาน์เตอร์ล้างหน้า กรุหิน	Sink	✓		
9.00	**งานเบ็ดเตล็ด**	**Miscellaneous Works**			✓
10.00	งานสี	Paint Works	✓		
11.00	งานบ่อบำบัด	Water Treatment			✓
12.00	งานบ่อหน่วงน้ำ	Retention Pond			✓

Source: Author (2018)

3.3 Tools and data transitions

Using Autodesk Revit as BIM software initiates primary model in architectural aspect and some based building structure, and others relevant software for quantity take off. This modeling experiment is a tangible outcome that can be proved and measured the success of result. As mentioned earlier, the quantity takeoff process in this experiment utilized data from more than one source, data transferring and transitioning are therefore one of the main keys of quantitative analysis, Figure 5 demonstrates that there are two paths of data flow into BOQ template towards to the end. One is the direct quantification take off which is explained by countable items (e.g. number of column, volume of concrete, area of finishing), on other hands indirect take off items are considered in additional calculation and put specific formula (e.g. formwork or unbuilt elements) that need to be transferred to Autodesk Navisworks for setting up all indirect calculation and target material searching then export to BOQ form in Microsoft Office Excel. The proportion of these combination confide in quantity take off process suitable for organizational goals.

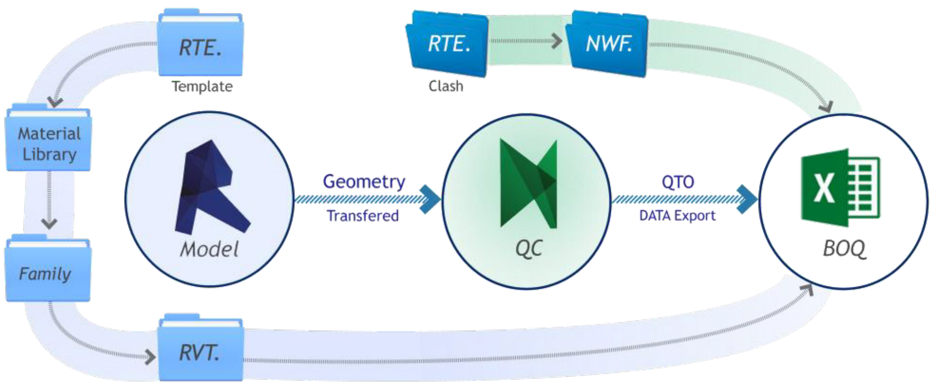

Figure 5 Tools and data transitions

Source: Author (2018)

3.4 Model management

As the master BOQ is kept as a standard, the modeling procedure shall be organized to best match elements in the BOQ. Figures 6 and 7 below describe the modeling sequence based on the sample of L.P.N. Development PCL product, which reflects master BOQ format. The modeling procedure has been managed by establishing the coordination and building upon skeletons in structure (e.g. column, core, stair, and floor slab). The model must be built as same as the construction method in order to get the right quantity. Typical room types are to follow the product standard and inserting to typical rooms on the right coordination after whole building structure has completed. The last sequence was duplicating and stacking typical floor upward then completes the rest of elements. Quality check is the key significance of quality control by avoiding wrong output from insufficient input step. Restricting the quality check in every transition modeling step would prevent the final quantity error.

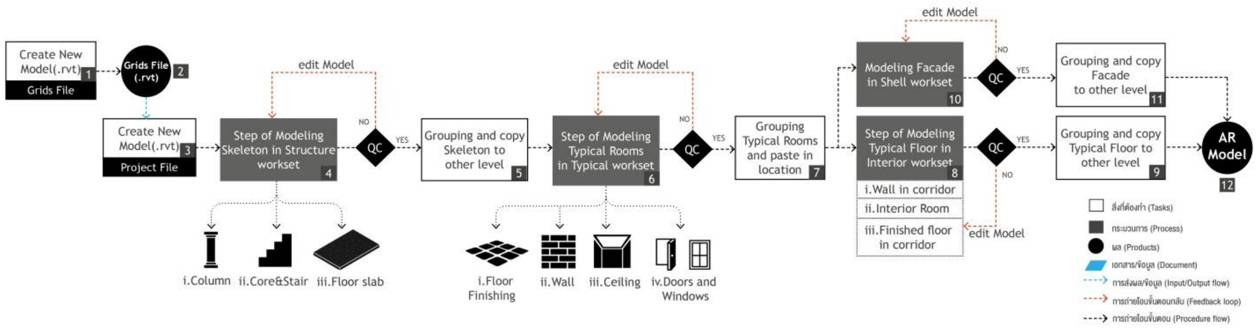

Figure 6 Architectural modeling workflow

Source: Author (2018)

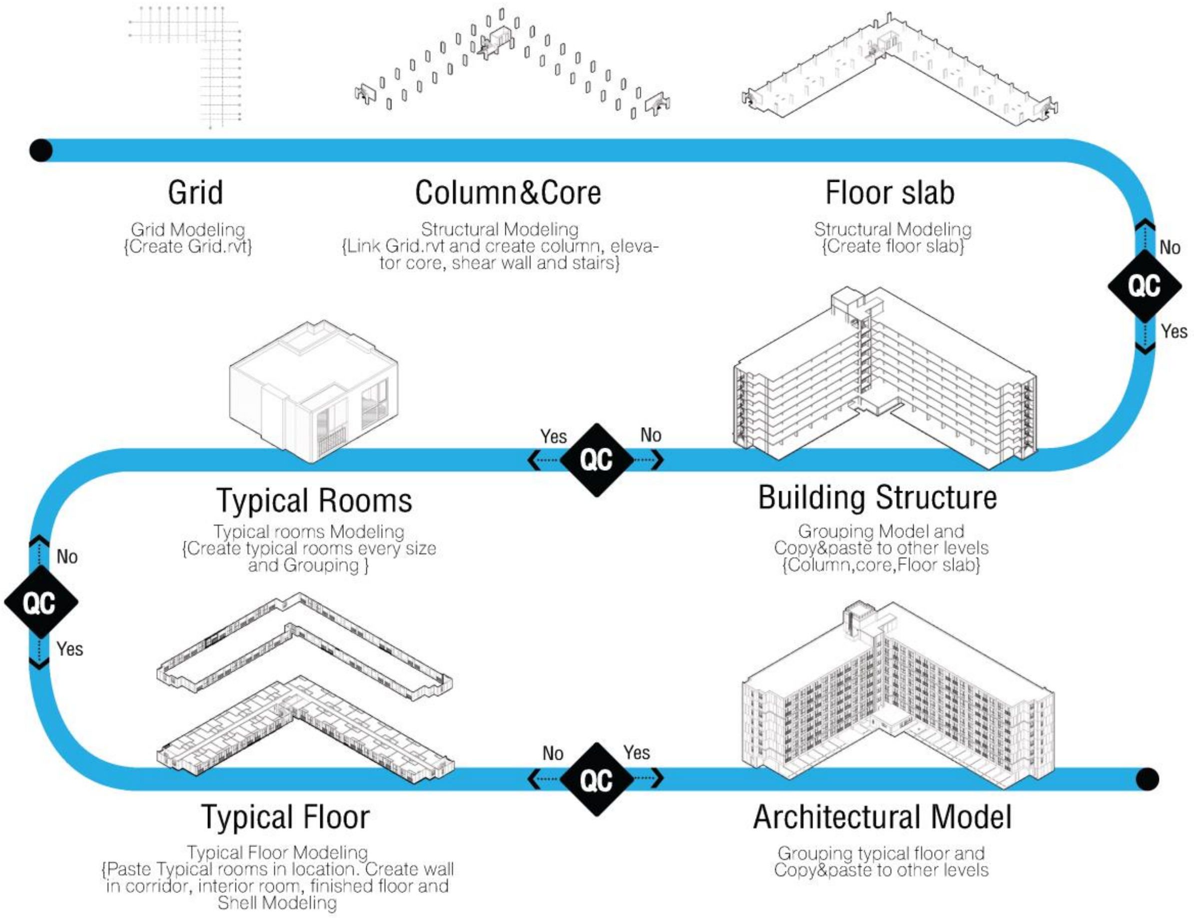

Figure 7 Modeling procedure

Source: Author (2018)

3.5 Family and materials management

The critical decision for cost accuracy is to choose the right assembling materials between basic wall and stacked wall. The basic wall (Figure 8: Top) is the typical wall type easily picks and drops for usual cavity walls and internal partitions. It is fast in the process when to model in lightweight wall, but custom surface elsewhere must be made for any modification or material variation. While a stacked wall (Figure 8: Below) of the modular wall allows a subdivided wall (both vertically and horizontally) into separate panels. It considers a weight lifted up the wall because there are multiple layers of basic walls in a stacked which required a systematical order and well manage for all materials. The major difference of quantity take off in architectural elements between basic and stacked wall is typical rooms. Considering the materials breakdown and the accuracy number of items, for instances, ceramic tiles above ceiling is unreal or the variation of tiles sizing on a wall is uncountable for basic wall but distinguishable through the five horizontal layers of stacked wall. The chosen hypothesis must be targeted on the efficient family and materials breakdown which able to clarify and provide proper matched through given BOQ.

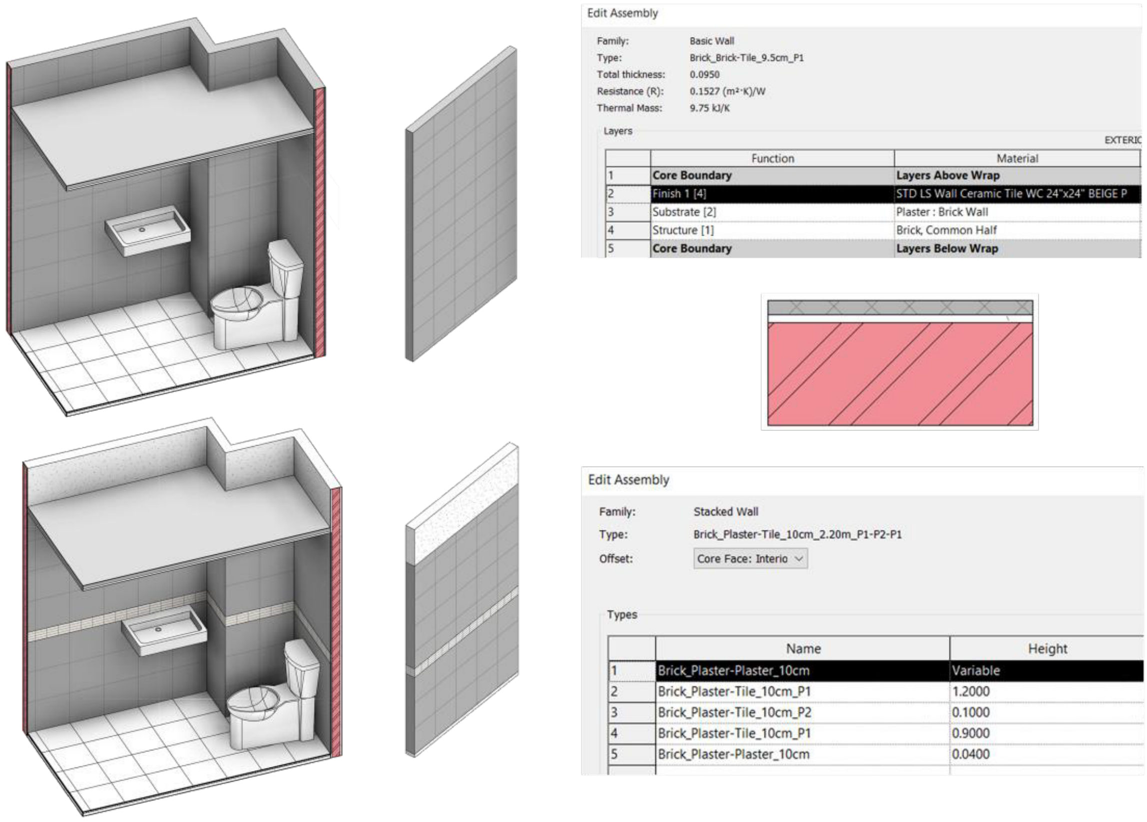

Figure 8 Basic wall (Top) and Stacked wall (Below)

Source: Author (2018)

4. Research result and summary

4.1 Summary of experimental criteria

The accomplishments of study discovered the significant factors of cost control, 3D modeling procedure, materials template, and QTO methodology. The result has shown the significant BIM aspects and criteria in the value of forecasting construction cost which will be discussed as follows:

4.1.1 Identify product and risk management

Product characteristic is a precaution to understand what to plan, how to do for entire cost control. The experimental modeling has used building design from L.P.N. Development PCL is the standardized design which provides a repeatable in terms of sizing, unit types, material specification, and common functions. Nevertheless, cost control for L.P.N. is to reduce the unknown risk or error after preliminary design while BIM could offer this opportunity if BIM embedded in the critical process of project life cycle. Combing the two values of standardizing design and control the target cost are the primary criteria.

4.1.2 Family and material template

The hypothesis experiment (Figure 7) aims to identify technical tool of building cost control and provide BIM modeling procedure and QTO template, which associates to the primary criteria in standardizing design and control the target cost. The stacked wall system is the perfect solution to achieve a higher level of control. The effort to push through material and family template will empower of cost control in building specification and able to replicate the entire process when the next target building has come. Direct and indirect items are to consider that Taiichi Ohno quotes (Toyota Motor Corporation, 2018) Just In Time (JIT) process identify what and how to model in the efficient time constraint. The architectural components are to break down and formulate in the proper mathematic calculation for those the indirect items which required the understanding of how the building will be assembling and constructing.

4.2 Quantity take off result

The result has shown the significant BIM aspects and criteria in the value of forecasting construction cost in order to extract the components under given Bill of Quantity (BOQ) with efficient QTO methodology. The result on this effort provides the number of countable as direct QTO and formulated as indirect QTO shows at least 70 percent (Figure 9) of specific architectural and structural components by the excluded underground structure in BOQ projection. While compared to a whole building and every aspect of disciplines (e.g. architecture, interior, structure, MEP) BIM model can offer up to 50 percent (Figure 10) of countable items for whole building categories. These quantity analyses provide the great opportunity to forecast target cost and ability to modify the design configuration.

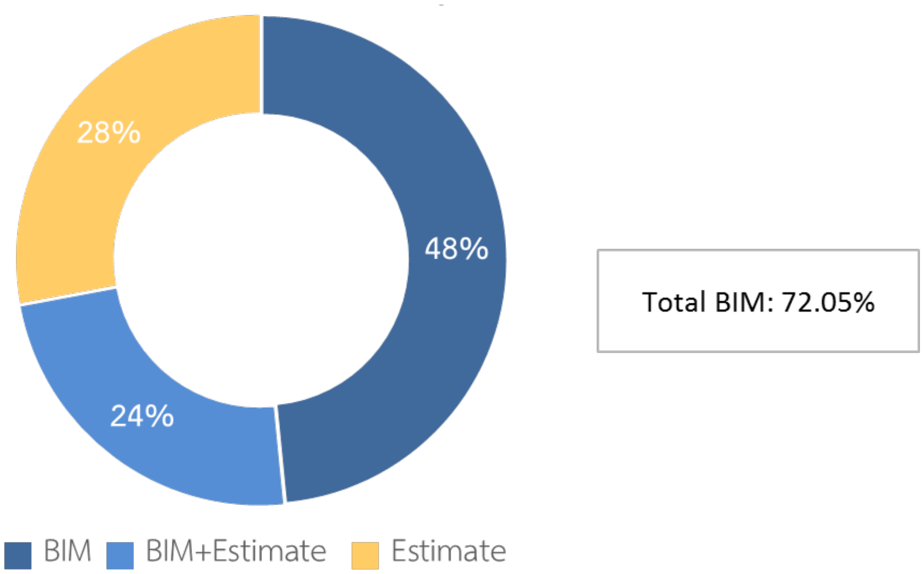

Figure 9 BIM Quantity Take Off based on BOQ in Architecture and Structure (excluded underground) for the whole building

Source: Author (2018)

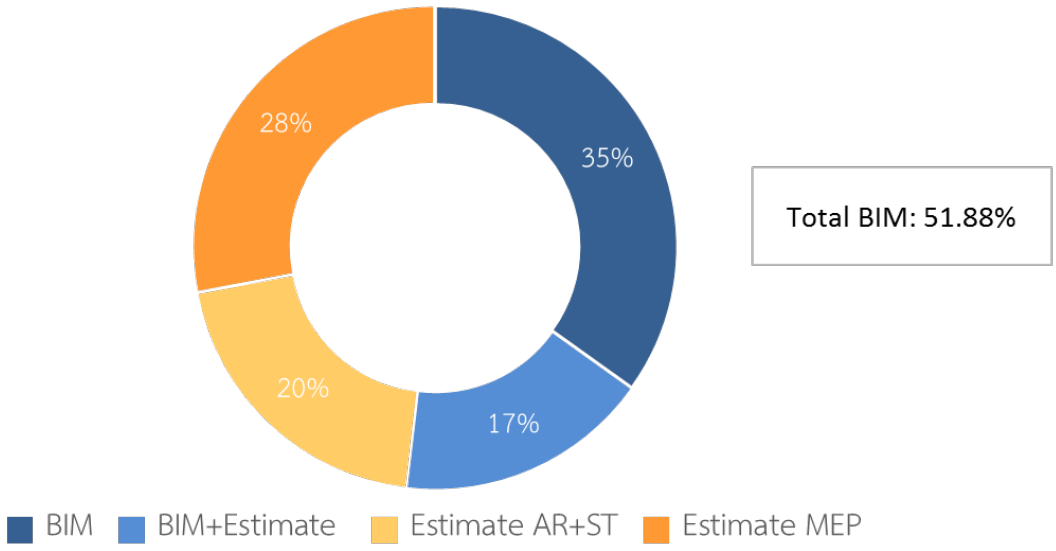

Figure 10 BIM Quantity Take Off based on BOQ in Architecture, Structure, and MEP for the whole building

Source: Tamonvun Emsirisangtong (2018)

5. Suggestion and recommendation

The lesson learn of this research has been discovered through technical workflow and method of forecasting on construction cost by using Building Information Modeling (BIM). However, the use of BIM must come after setting up the primary targets and identify proper criteria that responses to organization's objectives since each organization may look into the level of control differently. The factor of time verse quality shall be considered before introducing BIM strategies which may cause additional work, for instances, how much details that model need to be and what are the critical elements should model in time. Quality control is the significant important part that needs to clarify and manage for avoiding insufficient loaded and unreliable data. Last, the communication and collaboration among stakeholders (owner, designer, contractor, and quantity surveyor) require proper workflow and task responsible have to the key for transferring updated data.

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