PROJECT COST STUDY IN SITE MANAGEMENT- FINLAND VS VIETNAM

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Construction and Civil Engineering Abstract

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The success of a project and its effectiveness is decided by how well the project cost has been handled. There are high fluctuations of costs during the implementation of a building project which have a strong influence on the overall investment figure as well as on the progress of the whole development. The purpose of this thesis is to study in depth the definition, content, roles of the project costs as well as the factors influencing it.

The thesis is practice –based. For studying the project costs in Vietnam a case study was selected, a pharmacy located on 87 Tran Cung street in Ha Noi, along with professional's expertise, in this case, the director of Vitexco. The project costs in Finland are evaluated using Talo90, the Finnish cost estimation system. Factors influencing the expenses of the project such as human resources, design, risk, material, etc. are elaborated in the thesis for determining how these factors make an alteration to the project costs. Additionally, a comparison between the cost estimation systems between the two countries are examined further to see which system would be more optimal and see the strengths and weaknesses in each of them. The thesis also has two Appendices showing the process of obtaining a building permint in Vietnam and Finland

Keywords Project cost, Vietnam, Finland, effect of project cost, comparison

Pages 45 pages and appendices 4 pages

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Appendices

1 Introduction

A project cost plays an important role that directly reflects the effectiveness of a project, especially in the the construction field. The thesis will focus on a cost estimation and project cost in Vietnam and Finland. Additionally, the cost of a project can be affected by factors such as human resources, design, risks, materials, etc. Based on the case study, these issues are studied deeper with existing numbers taken from the case study. Moreover, the differences between the two countries will be shown in order to see which system is more optimal, what they can learn from each other.

The information in the thesis and the research method is based on existing numbers taken from the cost estimation of the case study, professional views and internet research.

Project cost management is the action of managing with planning, forecasting, control, cost finding, analysis and evaluation of the contractors and it is used to control the project cost. An effective project cost management is seen at the closure phase of the project, whether the project is completed on budget and with planned scopes or not, the money flow of the project shall be evaluated successful or not.

Fig.1 Main phases in project cost management. (Eby, 2017)

For a building to be built,a cost estimation shall be conducted before the project is executed, and each project needs to be legalized by the authority. Each country has a different process in applying for a building permit. The process in Vietnam and Finland shall be elaborated later in the Appendices.

1.1 Definition

Project cost is the estimated total cost required to start building a new project, construction price, facilities and devices, land market and as well as labor price. The cost of a project is indicated in different terms and determined according to each phase of the project investment. In each phase of a construction project, the cost appears in distinct constituents and names depending on functions:

In preparing phases: the project cost in this phase is indicated by the total investment money. The total investment money includes construction expenses, facilities expenses, project management expenses, compensation for land clearance, constructing counseling management expenses, back-up expenses and others expenses.

The construction expenses include the constructing price, demolition, ground filling, constructing of temporary houses to support the main project (for workers to live and to execute the construction procedure).

Facilities expenses: include the cost for buying devices; cost for training and technology transfer (if needed); installation, experiment and adjustment cost; transportation cost, insurance and others related expenses.

Project management expenses comprise of cost to organize and execute the project since preparing until the project is finished, put the project into use, supervising cost, appraise the project.

Compensation for land clearance comprise cost to change the purpose of use of the land; expenses for compensating the existing owners for their property (building and/or land).

Constructing counseling management expenses cover surveying cost; designing, project planning, constructing supervisor and other related counseling expenses

Other expenses include interest rate during construction time and other related expenses

Back-up expenses are arises expenses during construction process and back-up for inflation during construction process

In implementation phase: construction cost is based on the quantities calculated from the drawings of the building. Cost estimation comprises of the cost of the materials, equipment cost, management cost, construction supervision cost, other cost and back-up cost.

In choosing construction contractor phases (tendering phase): estimated price for each construction package, bid price, winning bid required price, qualification of bidder, contracting expenses.

In project closure phase: when the project is finished it is handed over and put into use, the expense of the project is the liquidate and final cost (Ministry of Construction of Vietnam 2020).

1.2 Role of project cost

The project cost is one of the main reasons to invest in a project.

The price of a project is a very important factor that will affect the stakeholder's decision in investing in it. Will the project be a good investment, or will it lead to financial loses? This is a very important question that will be asked at the beginning of the project and it will absolutely influence its future.

The project cost will determine the materials used for building, the quality and class of work and the technology to be used. The equipment and facilities can vary from low quality machine to high-end machine.

The project cost also helps all parties involved to stay focused on delivering on time and on (or below) budget.

Finishing the project on time and on budget are the most vital features for every single construction project. Regular update and meeting between each party will help in maximizing allocation of each party's job.

A proper project estimation will also warrant the objective and requirement of the whole project.

Completing a project on time is not the only requirement but meeting the customer's specification is also very crucial. Proper cost estimation assists in keeping disciplined approach towards construction activities to achieve customer's specification.

Fraud can easily be detected while keeping track on the budget.

Construction projects which have the tendency to overrun the deadline might be involved in some financial uncertainty. However, with a good cost estimation, contractors can easily keep tracks on those numbers, be cautios about any deviated cost, therefore can ensure the total cost will not overrun the estimations.

One of the most crucial features of cost estimation is to determine the timing of the project.

Cost estimation affects schedule and process considerably. There are so many features that can make a change in the cost estimation, for example labor work and supply of funds.

1.3 Phases of costs

1.3.1 First phase: preparing for the project

In the preparing phases, every paper work related to the use of land, legal documents about the executing of the project, choosing the type of architecture, finishing the surveying process, making the cost estimation must be finished so that one will be informed about the whole cost of the project.

The owner of a house should also know about the role of designing in order to save money. In addition, once having talked to each other, the designer and the owner can have an understanding and unify which one to use. How design affects the cost of the process will be elaborate in the next chapter of the thesis.

The owner should also get an idea about supervising and counselling so that the construction process will be executed smoothly, at the same time saving money. Supervisors and a counsellor should be chosen carefully, in case of fraud during the process. Fraud here means some material will be ”stolen” (for example 5kg cement to 4.5 kg of cement) for an individual financial purpose. This will make the owner lose money,and will at the same time decline the quality of the project.

1.3.2 Second phase: Executing the process

In the second phase, the work is to build, starting from the foundation, framework, roof, HVAC system, electric system, water pipe system, etc

During this phase, the cost is constructing, supervising and counselling costs. In this phase, the role of the supervisors will be crucial and can be seen easily. They will have to follow the building process, manage the quality of building, control the amount of material so that none will be used with the wrong purpose.

1.3.3 Closure phase of the project

Closure phase is the last phase of the project, the owner has to decide which kinds of material will be used for decoration, the color of the paint, style of the balcony, etc. The designer and contractor will show the owner some options to choose within the ability of paying. The main cost during in this phase is ” finishing the project costs”.

At the end of the project, the real cost of the project will be compared with the initial estimation to determine if that is a successful project or not, is the project financially beneficial or not, is the money of the owner spent worth paying or not. (Ministry of Construction of Vietnam-2008)

1.4 Research goals

The main goal of the thesis is to perform a study about the cost of a project, then make a comparison between the Vietnamese and Finnish system to see what are the strengths and weaknesses of each country, and what can be learned from each of the two systems.

The case study considered in the thesis witnessed a high fluctuation during the construction process, which bothers both engineers and the contractor. This fluctuation strongly affected the total cost of the project. With the alteration in the cost, the engineer had to re-design the structural part of the building and extra workers needed to be hired. To conclude from

the case study, the planning phases of cost management should be considered more carefully in order not to encounter the same mistake.

The information in the thesis and the research method is based on real figures taken from cost estimation of the case study, Internet research and a professionals' opinion, in this case, the director of Vitexco, Mr Hoang Cao Cuong.

The thesis is made with the purpose of evaluating how factors may influence the expenses, as well as the progress of a construction project, so that other projects can benefit and would not encounter the same mistake. Moreover, the difference between the cost estimation systems in the two countries are compared to see the strengths and weaknesses of each country.

The main research method is based on the case study, a one-floor pharmacy located on 87 Tran Cung street, Ha Noi, Vietnam,the examination of the figures taken from the cost estimation of the project. With the Finnish cost estimation, Talo 90 is taken as the main source of research, and from Talo 90, comparison is concluded.

1.5 What is a cost estimation?

Cost estimation is the process in which the whole price of a construction project will be forecasted with a defined scope. For an accurate cost estimation report, this information needed to be inquired:

- Resource requirement
- Price of each resource
- Duration of each resource is inquired.
- List of assumption
- Potential risk

Cost estimation in Vietnam is mostly conducted by ETA, F1, G8.

According to Vietnamese construction regulation, cost estimation report includes construction cost, construction management cost, construction counselling cost, other expenses and back-up cost, regulated as follow:

- Construction cost: direct cost, indirect cost, pre-tax and VAT
    - Direct cost: Material (including contractor's one), labor work, construction and facilities cost.
    - Indirect cost: * General cost such as general management of enterprises, management on site, insurance of employees submitted by employers,
        - Temporary houses
        - Other expenses not based on design such as: workers safety equipment, laboratory work (if needed),
- Pretax: the amount of interest that construction company make based on cost estimation
- VAT according to Vietnamese law:
- Equipment cost:
- Management cost
- Counselling cost
- Construction cost
- Risk cost

(Ministry of Construction of Vietnam-2020,)

2 Project cost in Vietnam

Construction industry in Vietnam has developed with a fast pace since the opening time, which attract the attention of global investors. With the economic reforms and revolution after the war, Vietnam is considered to have one of the fastest growing economies in the world.

With a fast growing pace, the total GDP in Construction Industry of Vietnam comprises for a large amount for significant economic growth, specifically 6.5% annually, with average 0.2% growth per year. Construction industry is forecasted to continue growing with the effort to

improve the quality of country's overall infrastructure in construction, civil residence, tourism facilities and housing projects.(Morder Intelligence ,n.d)

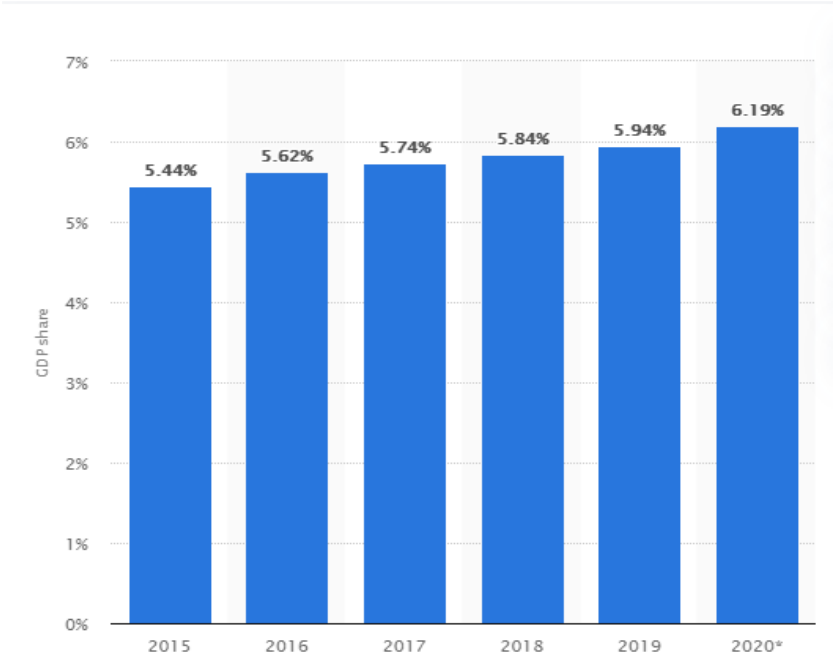


Fig 2. GDP of Construction industry in Vietnam. (Mordor Intelligence , n.d)

Fig 3. Share of Vietnam's construction output by sector 2014. (Mordor Intelligence, n.d)

In Vietnamese working environment and atmosphere, the most common form of organization used in a project is the line-staff.

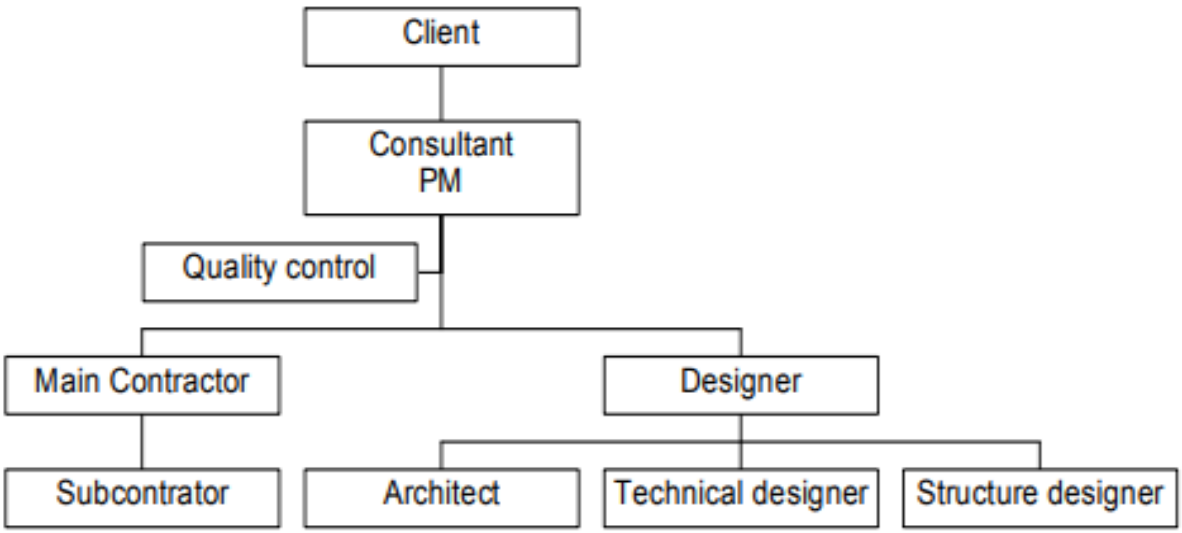


Fig 4. Working process of a project in Vietnam. (Viet.N-n.d)

Or a more simple method can be indicated as:

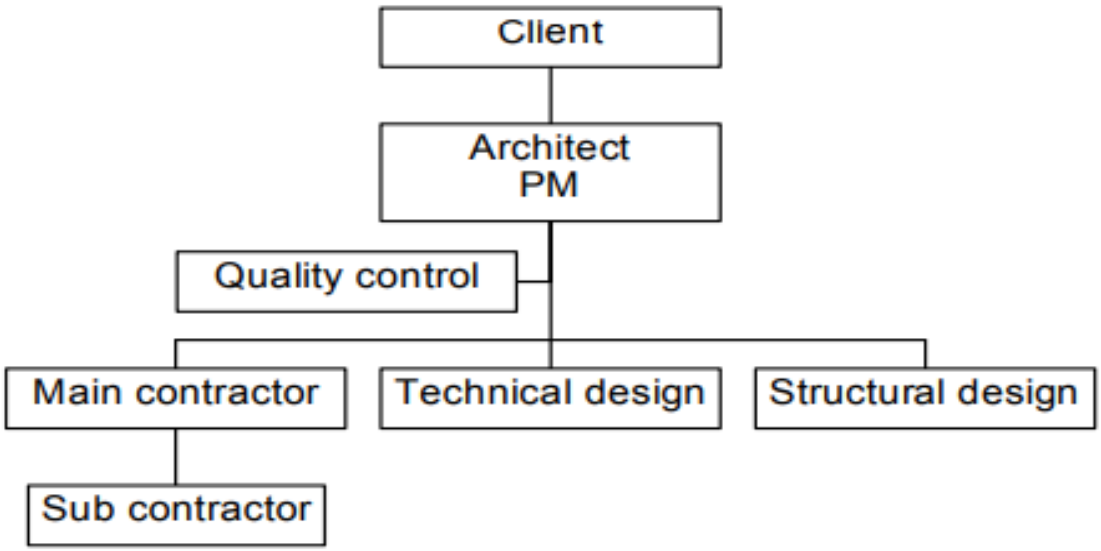


Fig 5. Another working process of a project in Vietnam (Viet.N-n.d)

The process of working for the one-floor pharmacy in the case study was almost similar to the latter working diagram. Since there were some changes during the construction process, the total expenses of the project were altered. (Viet.N-n.d)

2.1 About VITEXCO

2.1.1 About the company

Vitexco is a joint stock company established by Engineer, Master of Business Administration, Hoang Cao Cuong in 2013, organized and run according to Enterprise Law ratified by the Parliament of Socialist Republic of Vietnam.

Established during the economic crisis in Vietnam, rising was a challenge for Vitexco, but the company took that as a chance to grow and make a difference. With the massage of "bringing the nature to you", Vitexco has brought its own philosophy which is making living comfortable and close to the nature. Having visited Singapore and impressed by good air quality in the buildings and also by the fact that the nature was included inside the buildings (e.g. Tran Cung Pharmacy– trees were inside it Fig.6), the owner of the company Hoang Cao Cuong had decided to "bring the nature" to the customers so that his customers Benefit from the same standards as in Singapore.

Vitexco is an organization run by graduated Engineers from the best quality university in Construction site such as Hanoi Architectural University, National University of Civil engineering and have years of experience in the construction and economic field.

Since the first day of establishment, Vitexco always works with a motto: " The satisfaction of customers is our mission. We commit to deliver the best quality with the best price to the customers, at the same time bring the "nature" to your house". (Cuong.H-2013)

2.1.2 Projects built by Vitexco

1) Pharmacy located at 87 Tran Cung, Hanoi, Vietnam – The case study.

Fig 6: The look of the pharmacy as the case study

This pharmacy was designed in 2019, was built in the same year and finished in two months and a half with the whole expenses of 1,150,578,000 VND, equal to 42000 Euros. (1 Euro= 27.500 VND in 2019)

2) Another example could be Building of E hospital in Hanoi (87 Tran Cung)

Fig 7. Hospital in Hanoi built by Vitexco – Front view (Vitexco, n.d)

Fig 8. Hospital in Hanoi built by Vitexco – Isometric view (Vitexco, n.d)

Initially this building consisted of one floor, but during the renovation work in 2019, a second and third floor were added. The new addition was designed using steel elements, which is a new method of building in Vietnam (in use for less than 10 years). This building is used for research purpose of the hospital. (Vitexco -n.d)

3 Factors that affect cost of the project

Since playing a crucial role in the effectiveness of a project, cost estimation is conducted carefully, with ETA or G8 application. Every number, every item of work should be listed carefully, in order to keep track of work process, as well as avoiding fraud.

BẢNG TỔNG HỢP DỰ TOÁN GÓI THẦU THI CÔNG XÂY DỰNG

Dự án: .....

Gói thầu: Cải tạo, sửa chữa nhà thuốc số 1 - Bệnh viện E

STT	Nội dung chi phí	GIÁ TRỊ TRƯỚC THUẾ	THUẾ GTGT	GIÁ TRỊ SAU THUẾ	KÝ HIỆU	Cách tính	Tỷ lệ
[1]	[2]	[3]	[4]	[5]	[6]		
1	**Chi phí xây dựng của gói thầu**	**861,790,616**	**86,179,062**	**947,969,678**	**GXD**		
	- CẢI TẠO, SỬA CHỮA	861,790,616	86,179,062	947,969,678			10%
2	**Chi phí hạng Mục chung**	**30,162,672**	**3,016,267**	**33,178,939**	**Ghmc**		
	Chi phí xây dựng nhà tạm tại hiện trường để ở và Điều hành thi công tại hiện trường	8,617,906	861,791	9,479,697		Gxd x 1%	1.0%
	Chi phí một số công tác không xác định được khối lượng từ thiết kế	21,544,765	2,154,477	23,699,242		Gxd x 2,5%	2.5%
	Chi phí các hạng Mục chung còn lại						
3	**Chi phí dự phòng (GDPXD1 + GDPXD2)**	**44,597,664**	**4,459,766**	**49,057,431**	**Gdpxd**	Gdpxd1 + Gdpxd2	
	Chi phí dự phòng cho yếu tố khối lượng công việc phát sinh	44,597,664	4,459,766	49,057,431	Gdpxd1	(Gxd + Ghmc) x 5%	5.0%
	Chi phí dự phòng cho yếu tố trượt giá	0	0	0	Gdpxd2		
	TỔNG CỘNG (1+2+3)	**936,550,952**	**93,655,095**	##########	**GGTXD**		

Fig 9. Example of project cost. (Vitexco -n.d)

Translated into English this would be

Ordinal numbers	Content of cost	Price without tax	VAT	Price After tax	Label	Formula	Proportion
(1)	(2)	(3)	(4)	(5)	(6)		
1	**Cost of the whole project**	**861.790.616 VND** 31338 €	**86.179.062 VND** 3134 €	**947.969.678 VND** 34475 €	A		
	Renovate, build new structure	861.790.616VND 31338 €	86,179,062 VND 3134 €	947,969,678 VND 34475 €			10%
2	**Common directory cost**	**30,162,672 VND** 1097 €	**3,016,267 VND** 110 €	**33,178,939 VND** 1207 €	B		
	Cost for building temporary house for workers to live and execute on site	8,617,906 VND 313 €	861,791 VND 31 €	9,479,697 VND 344 €		A*1%	1%
	Cost of works that are not estimated in the surveying process	21,544,765 VND 783 €	2,154,477 VND 78 €	23,699,242 VND 861 €		A*2.5%	2.5%
	Other common directory costs						
3	**Back up expenses**	**44,597,664 VND** 1621 €	**4,459,766 VND** 162 €	**49,057,431 VND** 1783 €	C	C1 + C2	
	Back up for extra	44,597,664 VND 1621 €	4,459,766 VND 162 €	49,057,431 VND 1783 €	C1	(A + B) *5%	5%
	Inflation cost	0	0	0	C2		
	Total 1+2+3	936,550,952 VND 34056 €	93655095 VND 3405 €				

Note: 1 Euro equal to 27.500 VND, price in Euro is marked in RED

Table 1. Example of project cost in English.

3.1 Effect of human resources on project cost

Human resources are one of the most crucial factors directly affecting the process as well as the cost of the project. Human resources include labors, designers, supervisors, counsellors, security, etc.

Human resources in Vietnam have one big advantage: cheap and numerous. People from the countryside always try to find a job in a big city. Therefore, the sources of labor are always available with an affordable price.

As in the case study, the human resources include:

- 1 designer

- 1 supervisor
- 1 on-site executor
- 7 workers in total
- Outsource workers

All of the above-mentioned workers played an important role and directly affected the cost of the project.

The Designer: with the case study as a 1 floor and 100m^2 building, the salary of the designer for the whole project was 15.000.000 VND, equal to 545 Euros. This is the fixed price according to the term in the contract signed by the company (Vitexco) and the designer.

The Supervisor: The supervisor of the whole project was supervised by the vice director of Vitexco. Vitexco is just a small company with only 4 members, 2 accountants, 1 vice director and 1 director. To save the cost as well as make full use of the human resource, the vice director usually works as the supervisor of the project. He supervised work and made sure that everything went smoothly according to the schedule. The salary of the vice director was fixed according to the term in the contract signed by Vitexco and himself, which was about 25 million VND per month, equal to 910 Euros.

The On-site executor: The on-site executor was an outsource one, who signed the contract with VItexco during the executing of the project. His main job was to make sure everything went well on-site when the supervisor was away. He also took care of supervising and managing the workers, in case of workers' laziness or dishonesty. His salary was 10 million VND per month, paid by Vitexco according the contract signed by both sides.

The Workers: The worker team was hired by the supervisor. The mission of the worker is clear: to build the house. Workers must follow the instructions of the supervisor and on-site executor, so that the building will be the same as in the initial drawing, as well as handing in the work on time. The salary of workers was paid by Vitexco according Vietnamese law about salary: 7.300.000 VND per month, equal to 265 Euros. During break time(lunch, dinner), the salary would not be paid, but Vitexco support lunch and dinner money, 83.000 VND per day, equal to 3 Euros per day.

The Outsource workers: during crisis time of the project, outsource workers were hired to make sure that everything went on time according to the schedule. Outsource workers were working for the project for one month and a half and the salarya was a little higher than that of normal workers.

Taking a closer look at the human resources in Vietnam, despite the fact that the human resources are always available, numerous and cheap, the quality of workers is not as good as in other countries. The main source of workers is always from countryside. In a family, if the father is coming from countryside, and works in a construction project as a worker, he would have the tendency to get his son or his relative to work with him as well. And all the skills, such as bricklaying, placing steel, bending steel, pouring concrete will be taught by the senior workers, not taught by proper vocational school or proper training. This might lead to poor quality construction, a wrong method to approach to solve a problem, being stubborn and not obeying the instruction.

During the process of the project, the designer, the supervisor and the on-site executor would have a fixed contract, and cannot be replaced during the whole project. The main human resources that affect the project cost as well as the process are the workers.

Why do the workers affect the cost as well as the process of the project?
First of all, workers are the main human resources that will deploy the drawing, which means transferring the idea and design of an architect into real life. Without workers, no work will be finished, nothing will be built and the project will never be done. Usually in Vietnam, in the worker team, there will always be one “chief” of the team. The chief has the mission to take order from the designer and the company, elaborate it to his team, then build based on the drawing, the counselling and supervisor’s opinion. The chief has the responsibility to instruct his team on how to work and what to do in a project, and in case of any damage or any fault in building process, the chief will take the responsibility as well.

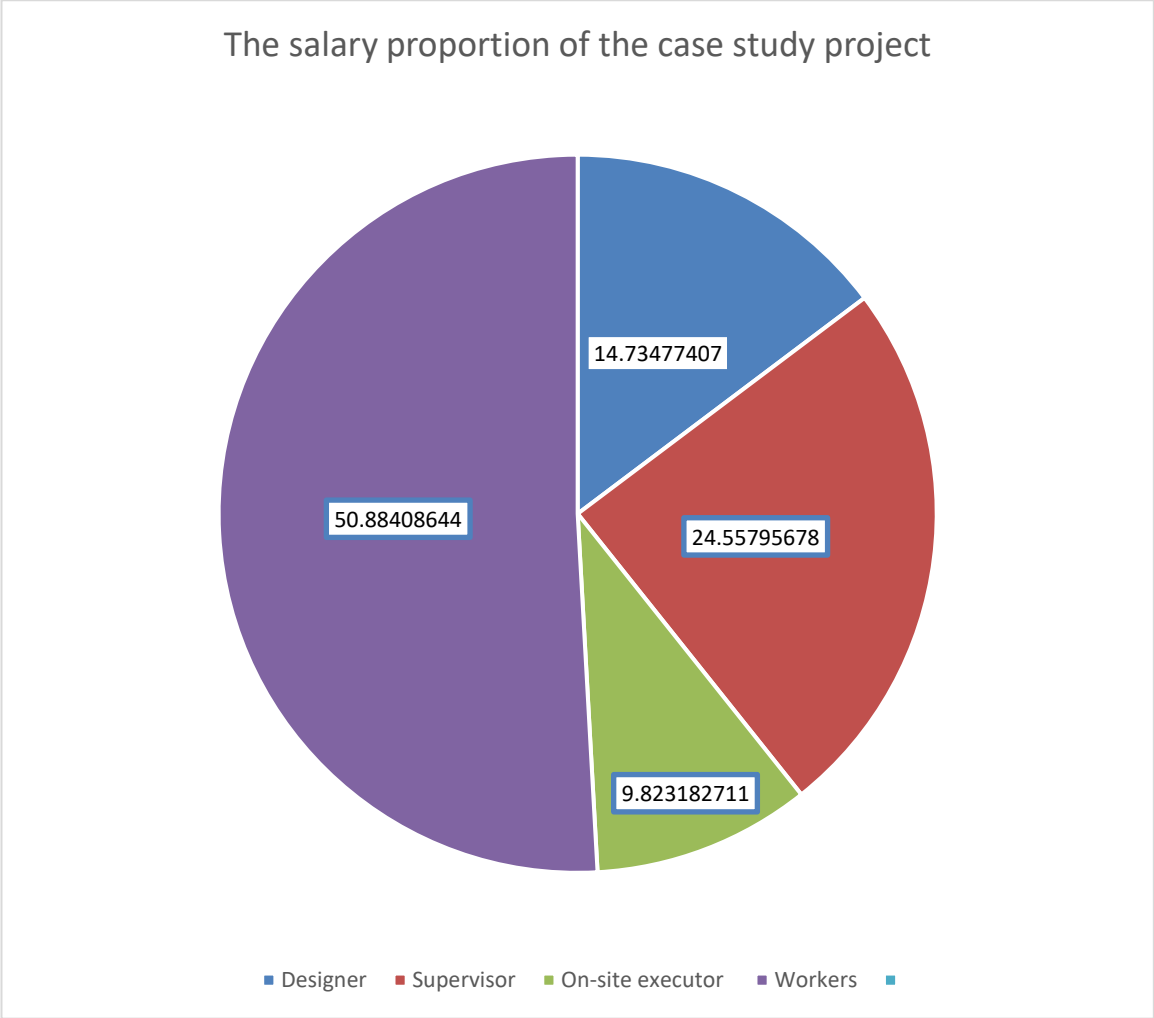


Chart 1 – Salary proportion in the case study project

As shown in the chart, the proprotion of workers'salary in the whole pie comprises for almost 51% of the whole salary pot, which means that the role of workers can not be underestimated in the whole project, and most of money used for salary is paid to workers.

Example: The salary of workers in the case study has some fluctuation because two out of seven workers have to go back to their hometown to help their families with the crop for a month. These two workers left when the project was one month and a half till finish. They are not paid, but Vitexco had to hire some outsource workers for the remaining time of the process. However, the price of hiring workers at that time was difficult, and Vitexco had a solution which is to pay more to the outsource workers, from 7.300.000 VND to 8.000.000 VND for the remaining time.

The estimated money to be paid for workers	7.300.000VND * 7 workers * 2.5 months= 127.750.000 VND

The real amount of money paid for workers	7.300.000*7(first month) + 7.300.000*5 + 8.000.000*2 + 3.650.000*5 + 4.000.000*2 = 129.850.000VND
The difference	2.100.000 VND (equal to 77 Euros)

3.2 Effect of design to project cost

Design also affects the cost of the project.

In the case study, the original plans based on the area after surveying and on the owner's idea and will be seen in Fig.10 to 17

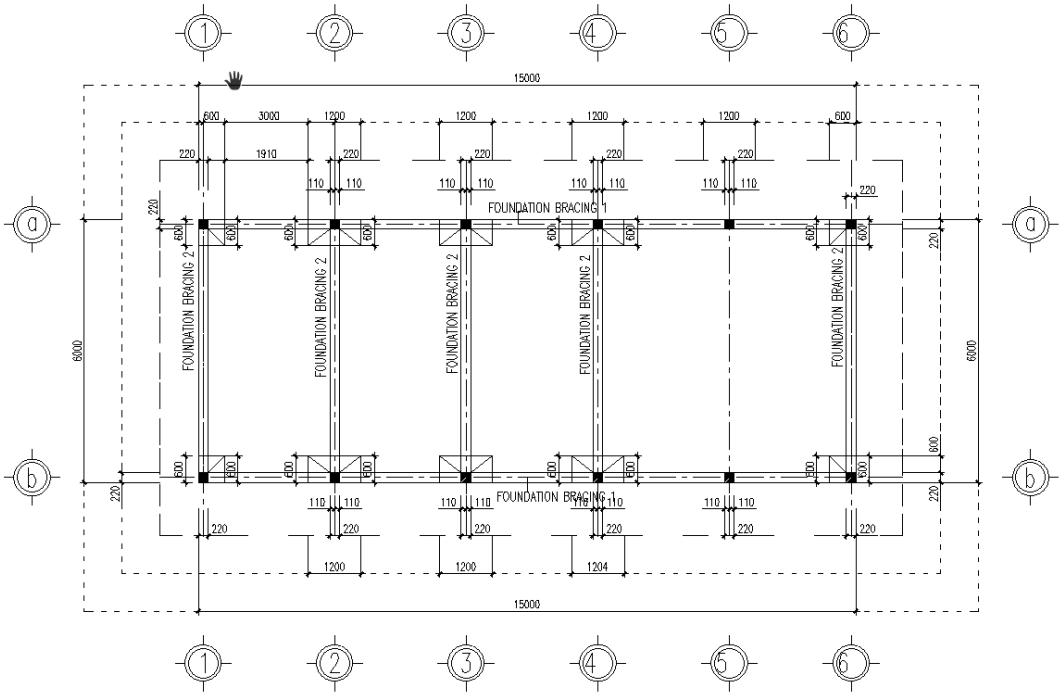


Fig 10. Initial foundation bracing system.

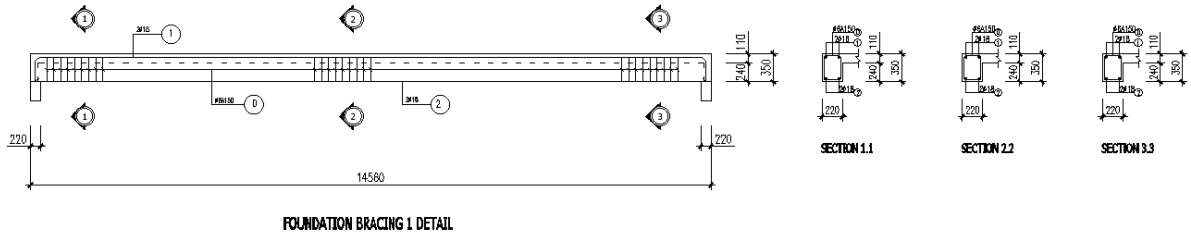


Fig 11. Foundation reinforcement 1 detail

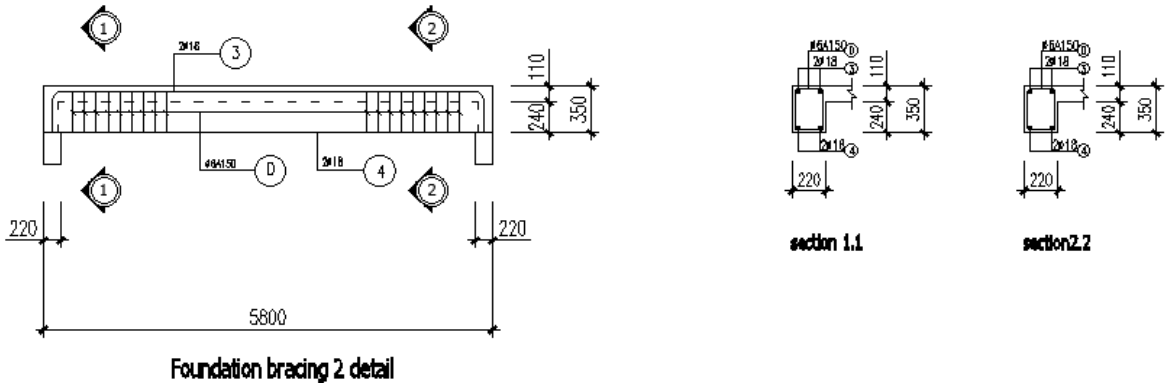


Fig 12 . Foundation reinforcement 2 detail

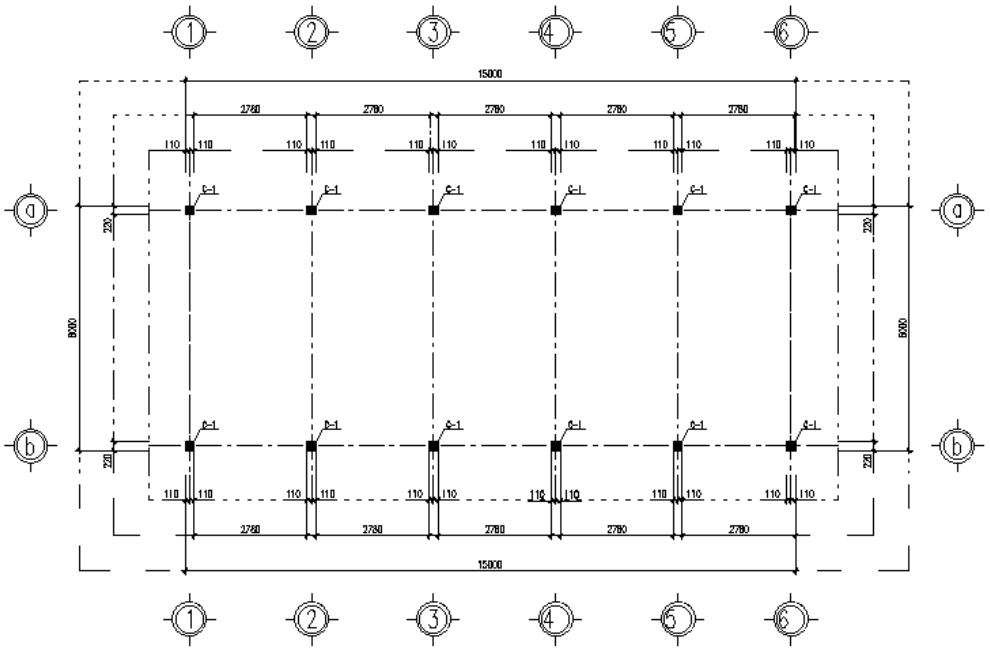


Fig 13 . Initial column layout.

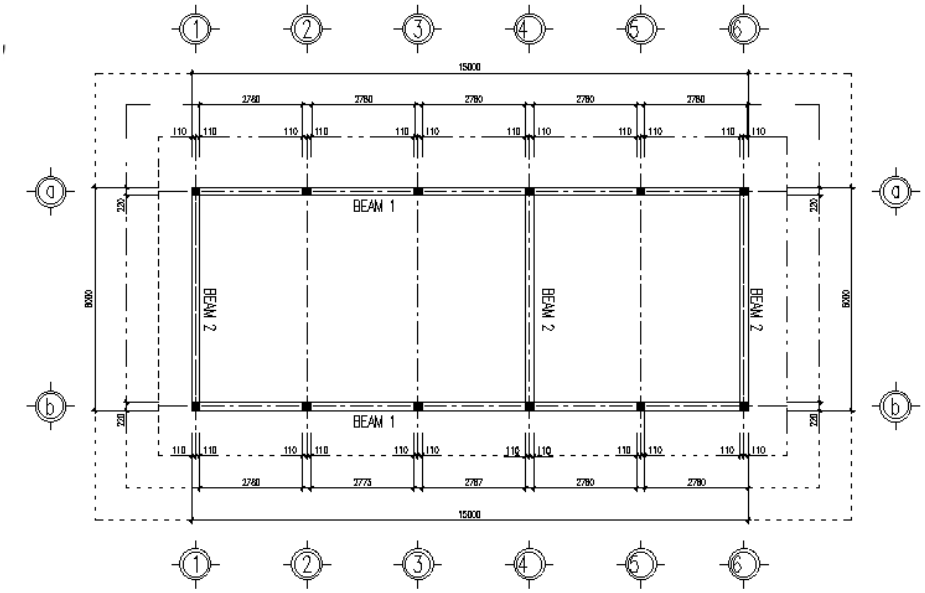


Fig 14. Initial beam layout.

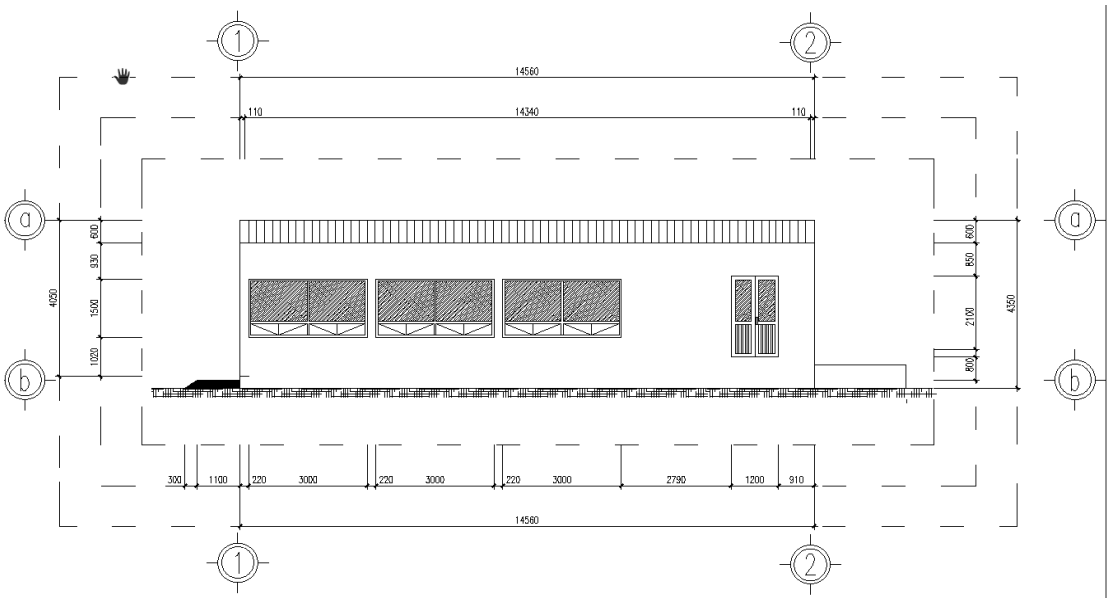


Fig 15. Initial facade of the pharmacy

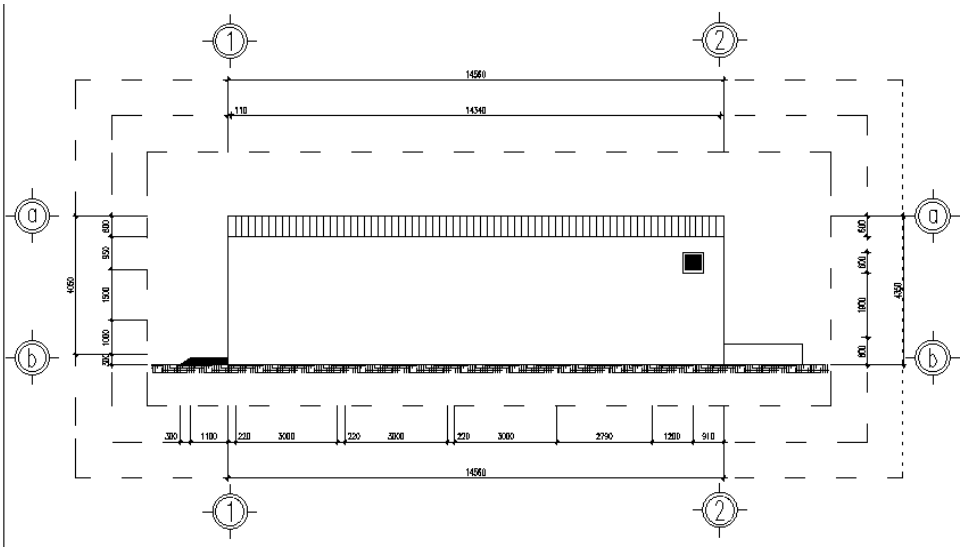


Fig 16. Initial view from the backside of the pharmacy

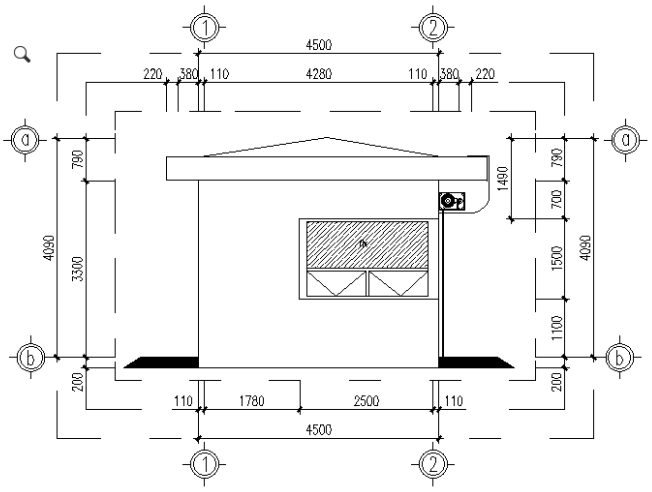


Fig 17. Side view of the pharmacy

This was the initial design that was shown to the client, the client wanted to make some changes to the facade of the building. In addition, after going to the area used for building the pharmacy, the designing and calculating team discovered some obstacles and faults with the initial drawing. More beams and one more column had to be added to ensure that the house would not collapse. The changes can be seen in Fig.17 to Fig. 20.

This affected the initial cost estimation. Once the problem was completely solved, the final design was approved by both the president and customer.

In the final design, one beam was extended in length, which increases the cost estimation and the real cost from the initial price, plus, the change of design in the facade also increases the cost compared to initial price.

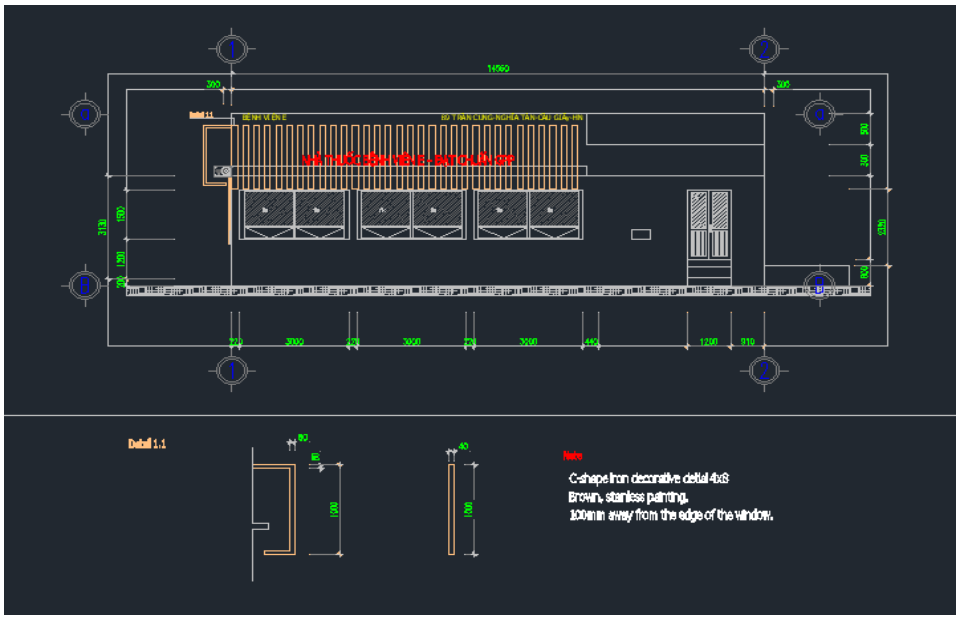


Fig 17. Façade of the new pharmacy.

The C-shape decorative detail was added to the building according to the idea of the client. All the C-shape details costed 5.600.000 VND, equal to 200 Euros. The installment was conducted by another outsource team, which cost the owner 2.750.000 VND more, equal to 100 Euros.

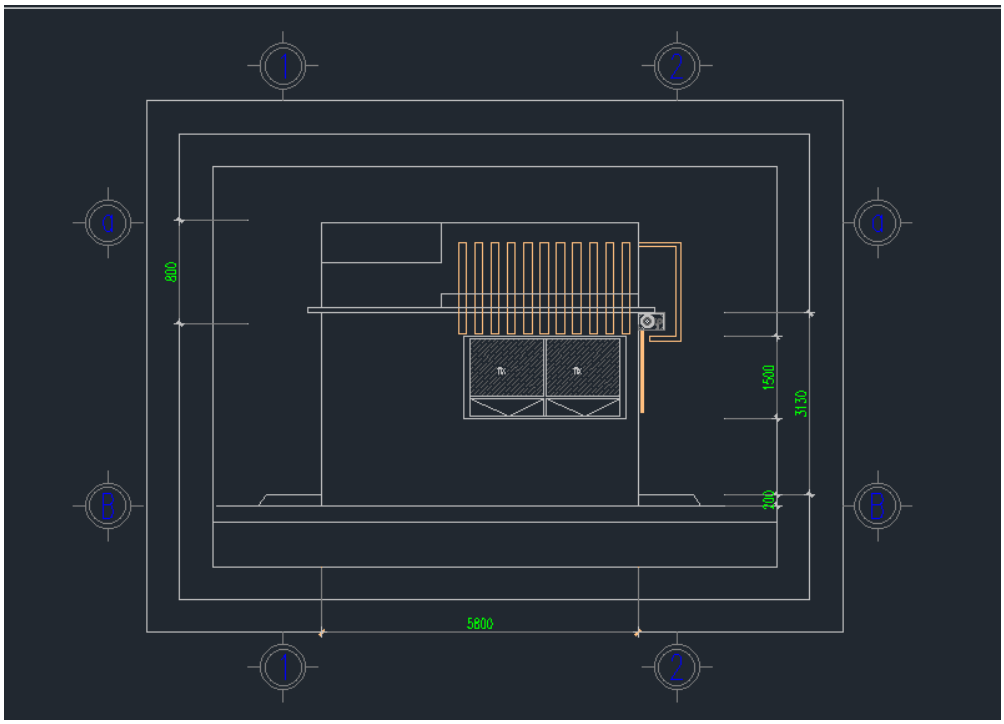


Fig 18. Side façade of pharmacy

Due to the change in the design, the side look of the pharmacy also changed, made it look more catchy and more modern. With only 300 Euros more, the look of the pharmacy changed in a good way.

After the on-site supervisor had gone to the field and did some real measurement, and talked with the clients about the situation, the frame of the house ought to be strengthen. The change in designing the frame consideralby affected the cost of the project.

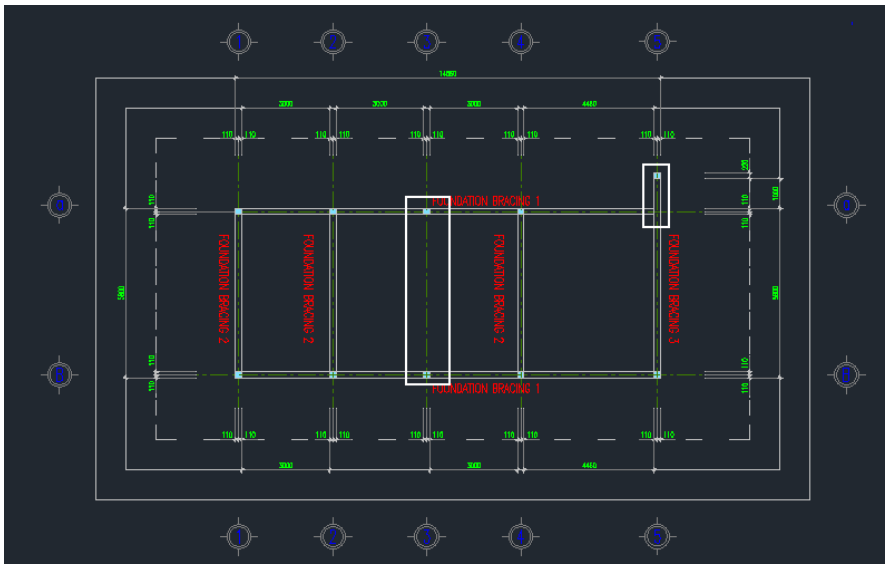


Fig 19. Final foundation layout

This is the foundation layout after the surveying. After the condition survey, one foundation bracing had to be taken away since in that place, there was a water tank, and one bracing was extended in length. With the extension in length, one more column was also required to be added in order to ensure the structure of the house.

With the change in the foundation bracing system, the frame work of the pharmacy had some changes as well.

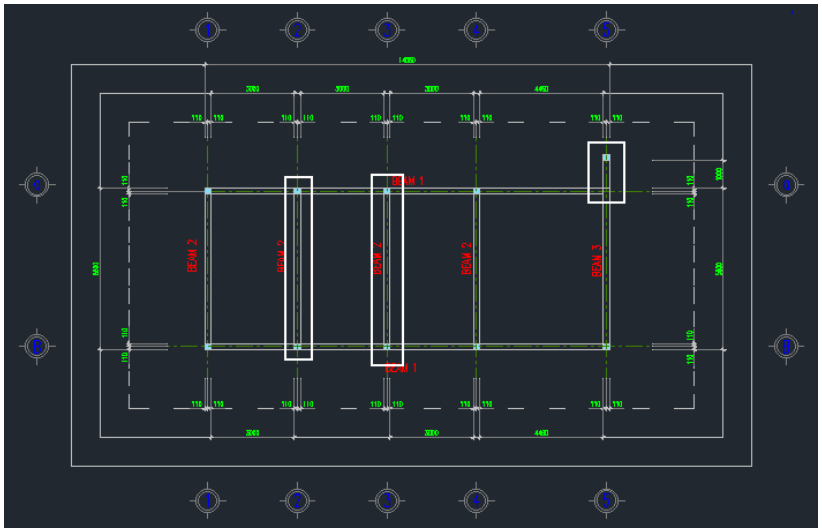


Fig 20. Final beam layout.

Two beams were added, compared to initial plan, and with the extension in the lenght of the bracing, one beam was also needed to be extended in length. The length to be extended was 1 meter.

	A	B	C
1	Difference of initial plan and finla calculation		
2			
3		Initial plan	Final calculation
4	Foundation bracing	2 FB1 and 5 FB2	2 FB1, 3 FB2 and 1 FB3
5		Dimension of FB1 : 220*350*14560mm. Dimension of FB2: 220*350*5800mm	Dimension of FB1 : 220*350*14560mm Dimension of FB2 : 220*350*5800mm Dimension of FB3 : 220*350*7020mm
6	Cement (m3)	4.47524	4.12258
7	different in the amount of cement (m3)	-0.35266	
8	Steel (kg)	464	427.2
9	different in the amount of steel (kg)	-36.8	
10			
11	Beam layout	2 Beam 1 and 3 Beam 2	2 Beam 1, 4 beam 2 and 1 beam 3
12		Dimension of Beam 1: 220*350*145600mm Dimension of Beam 2 : 220*350*5800mm	Dimension of Beam 1 : 220*350*14560 Dimension of Beam 2 : 220*350*5800 Dimension of Beam 3 : 220*350*7020
13	Cement (m3)	3.58224	4.56278
14	different in the amount of cement (m3)	0.98054	
15	Steel (kg)	371.2	473.6
16	different in the amount of steel (kg)	102.4	
17			
18	Column	12 Columns	13 columns
19		Dimension of column : 220*220*3800mm	Dimension of columns : 220*220*3800
20	Cement (m3)	2.2	2.4
21	different in the amount of cement (m3)	2.4	
22	Steel (kg)	364.8	395.2
23	different in the amount of steel (m3)	30.4	
24			
25	total different in cement	3.02788	
26	total different in steel	96	
27			

Fig 21. Difference of initial plan and final calculation

The formula used for calculating the amount of concrete needed in a beam:

B*h*d whereas: b is the width of the beam.

D is the depth of the beam.

H is the length of the beam.

With this formula, the amount of concrete needed in one beam in m^3 can be determined, then the total amount of concrete for the project will also be determined.

As shown in the table, the total amount of difference in concrete is 3.02788 m^3. The concrete class that used in the project was M150, based on the Construction Regulation of Vietnam.

Properties for M150 concrete for 1m^3 of concrete can be seen in Table 2

Table 2. M150 concrete class properties.

Concrete class	Cement (kg)	Sand (m^3)	Stone 1x2 (m^3)	Water (liters)
M150	288.02	0.5	0.913	185

The price for 1m3 of M150 concrete is 710.000 VND, equal to 26 Euros. With the figured given above, then the total price difference is + 710.000*3.02788 = 2.150.000 VND, equal to 78 Euros.

According to the table, the difference in the total amount of steel is 96 kg, with the price of d18 steel (diameter =18mm) is 10700 VND/kg. Then the total price for steel increase is 10700*96= 1.027.200 VND, equal to 37.35 Euros.

The total price increase in designing compared to original planned price: 2.750.000 +2.150.000 + 1.027.200= 5.927.200 VND, equal to 215.35 Euros.

A misunderstanding between the contractor and owner, the lack of communication led to an increase up to 215.35 Euros in the total cost of the project. Through this example, designing process is seen to play an important role in project cost. With the right designing, good condition and area survey, not changing anything during the building process assist the process to go as planned. As in the case study, the work stopped for two days for contractor and owner to do the surveying again, re-design and calculate, which delay the whole project. Once the surveying and designing process is ensured, then the project can go as scheduled, saving both money and time.

Designing correctly from the first step directly affects the quality of the building. It enhances the quality of the building since everything is clear from the first step. Since the quality is ensured from the first step, in a long run, the owner does not have to spend so much money and time on repairing and renovating. As in the case study, after being changed in designe, through 1 year and a half of using until now, there has been no sign of deteriorating in quality, or no sign of need for renovation and repairing.

3.3 Other factors affecting the project cost

3.3.1 Material and construction cost.

Material can vary in form, design, price, etc. Choosing the right material will help the owner minimize the cost, enhance the look of the building, as well as prevent possibilities of structural failure and rehabilitation.

Material in Vietnam has so many advantages, however, the quality of material should be considered in Vietnam.

With high humidity and also high in temperature, choosing material in Vietnam is challenging and totally different from Finland. With high temperature during the year and high humidity, the most suitable material for construction is sand, stone and cement. The exploitation of sand and stone in Vietnam has developed with a fast pace, which provide more and more material used for construction every year. In addition, Vietnam has a lot of lakes and rivers, as a result, fresh water supply in Vietnam is rich and always available.

As for steel material, Vietnam shares the border with China, the factory of the world, so the price of steel in Vietnam is much cheaper than in other countries among Asian region. Due to the richness in natural resources, Vietnam is fortunate to have many iron and metal mines, and with the fast pace in developing of technology, the amount of exploited iron will be formed into steel used in construction industry. All the advantages above lead to the cheaper price, availability in steel.

However, construction industry field in Vietnam has to face a problem, which is fake and poor-quality material. Therefore, the supervisor and counselor have to be wise to choose the right material that meet the demand of the customers and avoid poor quality material.

With the case study, the initial idea of the owner was to build the pharmacy with wooden floor. But due to the limited amount of money provided, the design team had come to a conclusion to use ordinary finishing stone.

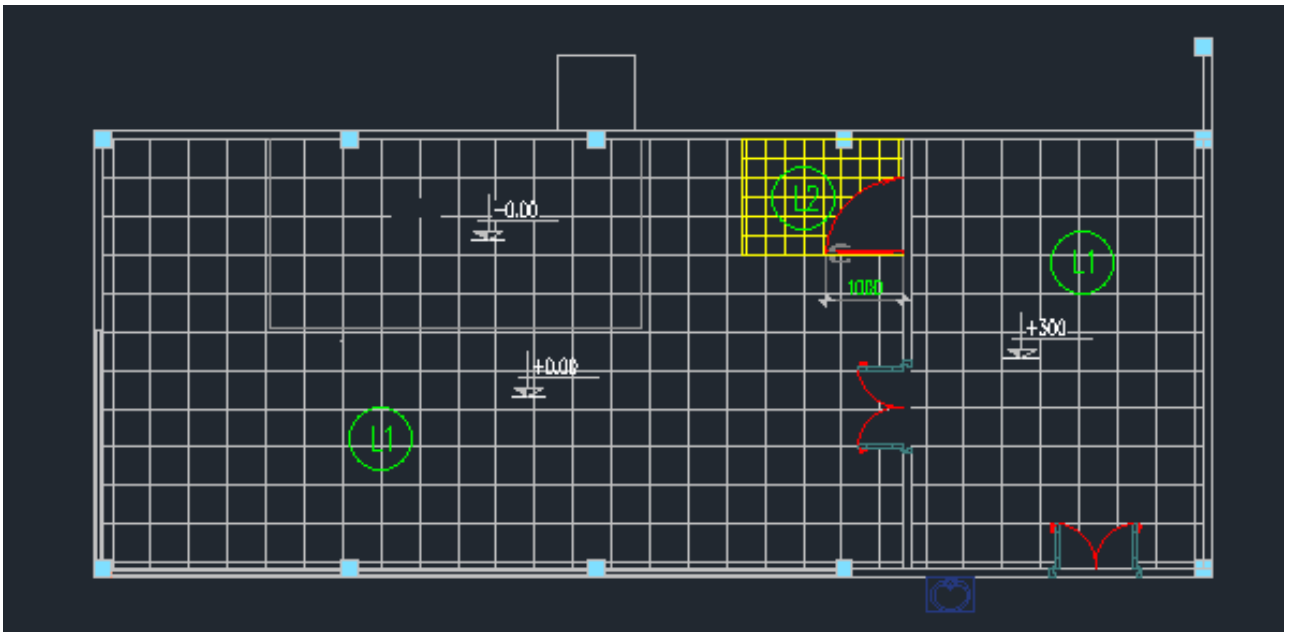


Fig 22. Total area of the case study.

The area of the pharmacy is 90m^2.

Table 3 . Comparison between two type of floors.

Wooden Floor	Stone floor
In the initial plan, the owner wanted the floor to be finished with natural wooden material, which cost 800.000VND/m^2 ⇨ The total amount of expenses with wooden material: 72.000.000 VND equal to 2618 Euros.	40*40 cm stone finishing, 100.000 VND per 1m^2 The total amount of expenses used for finish the floor with 40*40 stone: 0.16m^2*90m^2*100.000VND= 56.250.000 VND, equal to 2045 Euros

The price difference when choosing the cheaper (but still meet the requirements of the owner as well as the performance) is 15.750.000, equal to 573 Euros.

Construction cost in Vietnam is categorized into 3 different types: type 1, type 2 and type 3. This category is based on the development of a city.

Type 1 indicates the more developed city and so on. In the case study, the pharmacy in located in Hanoi, the capital of Vietnam, therefore the construction price is Type 1.

Table 4. Building prices based on city type in Vietnam

Type 1 with the area under 100m^2	5.000.000 VND/m^2
Type 2 with the area under 100m^2	4.200.000 VND/m^2
Type 3 with the area under 100m^2	3.500.000 VND/m^2

When making cost estimation table, designer also needs to take into consideration the location of the building in order to make a good cost estimation.

3.3.2 Risk cost.

Risk cost consist of many different factors: inflation, accident during the constructing process, natural disaster, etc.

Inflation factor is the one factor the affects the cost of one project the most. The alteration in price, such as material, building or salary will affect the cost of the whole project, it may decrease or increase significantly compared to initial cost estimation.

Accidents during construction project should also be taken into consideration when constructing. Insurance cost being paid will increase the total amount of expenses of the whole project. In additional, natural disaster such as storm, heavy rain or earthquake can delay the project, which lead to the increase in the price.

3.4 Closure phase of the project

Closure phase is the last phase of the project. The owner has to decide which kinds of materials will be used for decorations, the color of the paint, balcony, etc. The designer and contractor will show the owner some options to choose within the price range. The main cost during in this phase is ” finishing the project costs”.

At the end of the project, the real cost of the project will be compared with the initial estimation to determine if that is a successful project or not, is the project financially beneficial or not, is the money of the owner spent worth paying or not.

4 Project cost in Finland

Regarding construction in Finland, first thing to be mentioned is Building 90 (Talo 90). Talo 90, in English is building, is a system first established in 1970, when the construction industry started a development program aiming at more effective use of electronic data processing

throughout the construction process. There were so many series of the program that were presented and used, and the latest version was published in 1993 and called Building 90.

Since Finland has additional rules in controlling both quality and costs of a building project by elements and construction, Talo 90 was invented in order to create a new general classification which covers the entire building construction process from a client's brief to handover and maintenance supporting new methods in design and production control. Building 90 follows the propositions of ISO/TR 14177, Classification of Information in the Construction Industry (1994). Building 90 has two majors properties: Specifies a series of classification tables to be used for indexing purposes throughout the construction process, states method to be used for cost estimation and control purposes.

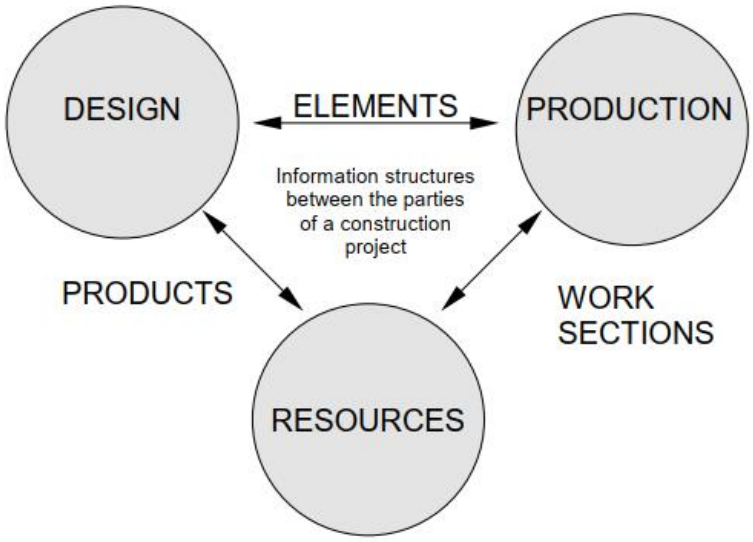


Fig 23. Relationship between activities and classification tables. (Talo 90 – 1999)

Cost estimation system:

In Building 90, the key concept is structure, in which:

-Product Structures: the end product building structures- produced in the building and mechanical design process where the building is described as elements which further are broken down into work section.

The product structures is the first breakdown in a contractor's plan and estimates. In production, cost estimation is devided into two different sections: tender estimation and target estimation, in which tender cost estimation is based on an elemental bill, which may

be itemised by activities when needed, whereas, target estimation is based on a schedule of work sections.

Building 90 method can be defined as an information control system which applies the Building 90 classification. The method comprises of applications for different tasks and as its core has a documentation system with: plans and drawings, bills and schedules and estimation and budgets, which will all affect the cost of one project to be built in Finland and in general.

The Building 90 classification tables are used in all building design and construction activities which need information transfer or sorting, as in plans and drawings, bills and schedules, estimations and budgets.

For project management, the classification table are used in design-brief, in pre-contract stage cost planning, in bills of quantities, in priced bills of quantities, in tender comparision and in definitions of the limits of various contracts.

Contents inherit →

Plans and drawings describe the result	**Bills and schedules** control the activities	**Estimates and budgets** support the cost control
	Brief solution	
project plan	schedule of spaces	target price budget
	Design solution	
preliminary drawings preliminary specification	elemental bill	elemental estimate
general drawings building specification con- struction drawings	product structure schedule	product structure estimate
specification of spaces	space structure schedule	space structure estimate
	Production solution	
production drawings detail and assembly drawing	production schedule	production estimate cost plan
production plans	activities schedule	activities estimate
programmes	procurement schedule	procurement estimate
	Maintenance solution	
maintenance manual operations manual maintenance plan	space schedule installations schedule	maintenance budget control accounts

Fig 24. The document system of Building 90. (Talo 90 -1999)

The Building 90 method is a comprehensive one, reaching from preliminary estimates of design process through production control and finally into accounting of final cost. The information flow from activities to documents during the construction process is indicated in Fig.24.

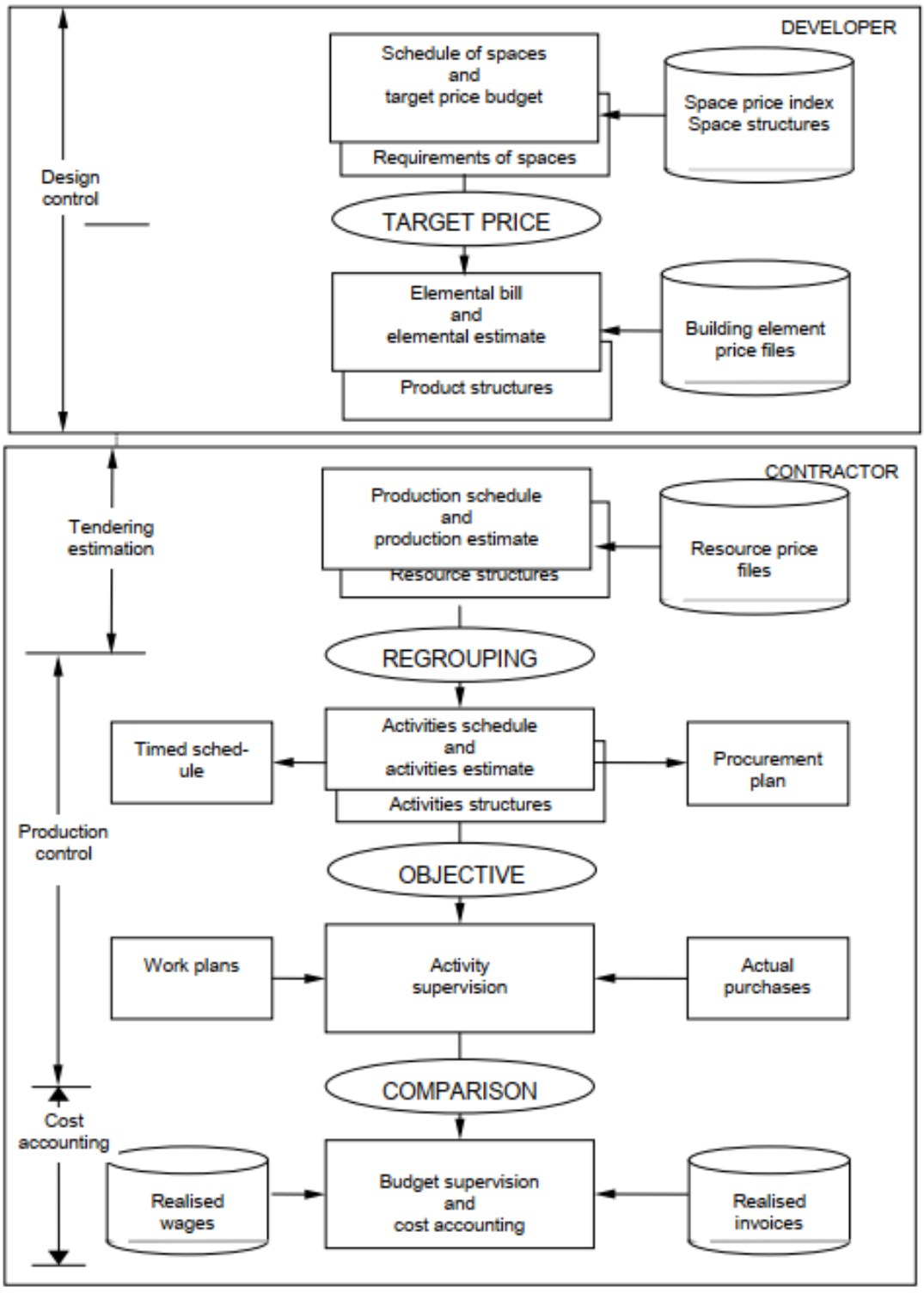


Fig 25. The comprehensive of Building 90 method. (Talo 90-1999)

4.1 Cost estimation and planning during the design phase

The building cost is set during the planning of the project stage on the grounds of the brief and the program space. It takes into account the costs caused by the space requirements.,

which are obtained from the activities occurred in the spaces.

Building 90 26.1.1999

Space requirements

Requirements	unit	value	commentaries
2 rooms + kitchen + sauna			
1 Measurements and form			
room area	m2	55,0	
width * depth	m2	6,1 * 9,0	
floor to floor height	m	3,0	
room height	m	2,7	
span	m	6,1	
2 Interior climate			
temperature control	C	> + 22	no refrigeration
cooker hood, sauna fresh air	euro/m 2	5,50	
incoming air speed			normal
air evacuation	l/sm2	0,5	
humidity			no humidifier, normal
3 Sound insulation			
partitions between premises	dB	56	
premise entry doors	dB	34	
4 Lighting			
external wall windows	m2	6,6	
illumination	W/m2	10	
windows on opposite walls	%	100	
:			

Fig 26. Space requirements in planning stage. (Talo 90-1999)

The target price budget is determined by means of space structures. The public index of target price of space is updated and revised annually. (Talo 90-1999)

Building 90 19.1.1999

Space program and target price budget

space	No.	description	pcs	m2	euro/m2	euro, total
1122	1	2 rooms + kitchen + sauna	9	522	661	344781
113	2	3 rooms + kitchen + sauna	9	645	632	407318
115	3	5 rooms + kitchen + sauna	9	951	592	563309
		Total dwellings	27	2118		1315408
1271	4	dwelling storage	4	18	546	9822
721	5	washroom	4	12	1227	14722
711	6	locker room	4	68	738	50207
731	7	toilet	4	8	1307	10457
821	8	inventory storage	3	94	552	51919
		:				
		Total programmed spaces		2703		1645515
911	15	horizontal communication space	3	19	764	14516
921	16	stairwell	3	180	544	97950
99	17	technical space	3	69	449	30958
		Total all spaces		2971		1788939

Fig 27. Target price budget (Talo 90-1999)

The initial prices and drawing are estimated base on the basis of elemental bill and estimate, and it is compared to the target space budget of the building project. (Talo 90-1999)

Building 90 19.1.1999

Elemental bill and estimate

BE	ID	Item	quantity	unit	euro/unit	euro, total
F2	**STRUCTURAL FRAME ELEMENTS**					202934
		:				
F27	**Floor slabs**					
	VP1	hollow core slabs 200 jv 7m pk easy	54	m2	28,48	1538
	VP2	hollow core slabs 265 jv 7m pk	2463	m2	34,17	84153
	VP3	hollow core slabs 265 jv 7m A120	272	m2	42,42	11537
	VP4	in situ concrete slab 200 board molding	268	m2	25,50	6834
		:				
F6	**INTERNAL SURFACES**					184157
	AS1	2 rooms + kitchen + sauna	522	m2	68,82	35922
	AS2	3 rooms + kitchen + sauna	645	m2	76,38	49267
	AS3	5 rooms + kitchen + sauna	951	m2	55,47	52749
		:				
F7	**INTERNAL EQUIPMENT**					251567
	AK1	2 rooms + kitchen + sauna	9	pcs	3639,67	32757
	AK2	3 rooms + kitchen + sauna	9	pcs	3991,17	35921
	AK3	5 rooms + kitchen + sauna	9	pcs	5060,83	45548
		:				
C	**SITE GENERAL**					235543
	TY1	cost bound share	14500	h	12,92	187292
	TY2	volume bound share	3406	m2	14,17	48252

Fig 28. Elemental bill and estimate. (Talo 90-1999)

In additional, in elemental estimate and space infills-internal surfaces and equipment are still handled as characteristics of space.

The unit costs of spaces are determined by the means of space structures which consist of product structures, building element enclosing and linking spaces. In order to serve the product structure, the building elements are broken down into construction products and work sections. (Talo 90-1999)

Building 90 26.1.1999

Product structures

BE/WS	R	WS/P	Item	quantity unit	quantity consumption	resource price euro/unit	BE cost euro/unit
F27 VP2		**Hollow core slab 265 jv 7m pk**		**m2**			**34,16**
22	2	22 060	joint reinforcement A400H 6-12mm	kg	1,500	0,48	0,83
25	2	25 021	hollow core slab 265 jv 7m pk	m2	0,902	36,80	32,16
23	2	23 110	jointing concrete K25 1-2 sVb 18mm	m3	0,017	64,25	1,17
F6 AS1		**2 rooms + kitchen + sauna**		**m2**			**241,91**
24	2	24 060	floor floating	m3	0,050	59,71	7,06
74	2	74 100	floor tiling	m2	1,000	20,80	41,69
51	2	51 150	studs c/c 600, quality V	m	5,760	0,668	30,94
56	2	56 021	ceiling boarding	m	10,500	0,630	27,55
			:				
C TY1		**Cost bound share**		**h**			**446,42**
09	5	09 010	management, responsible supervisor	mo	0,079		211,82
09	5	09 020	management, foreman	mo	0,048		92,61
			:				

Fig 29. Product structure. (Talo 90-1999)

4.2 Cost estimation in production

Cost estimation in production can be understood as a target price for the product to be finished, set by the tender, in construction project, it can be understood as the amount of expenses needed to finish the project.

In production, tender estimation and target building should be seen as different procedures. As mentioned, tender estimation is based on elemental bill, target budget is based on schedule of work sections.

The tender estimation aims at the pricing of tender, whereas the purpose of the production estimation is to set an objective for the contractor. (Talo 90-1999)

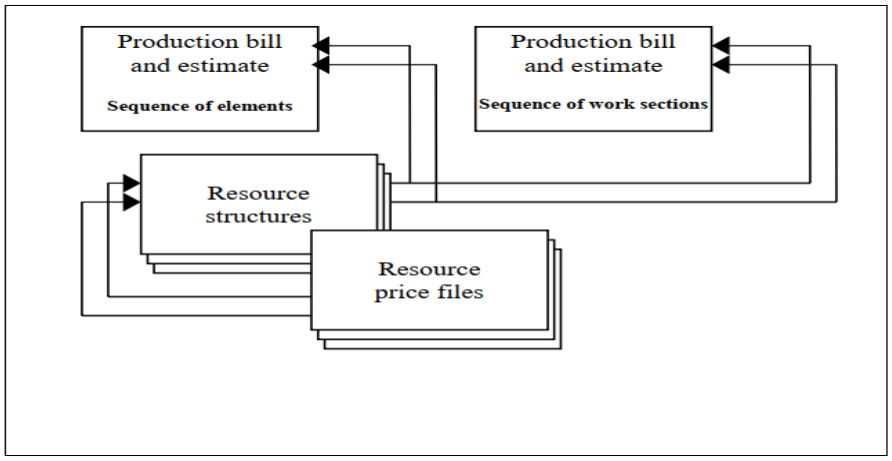
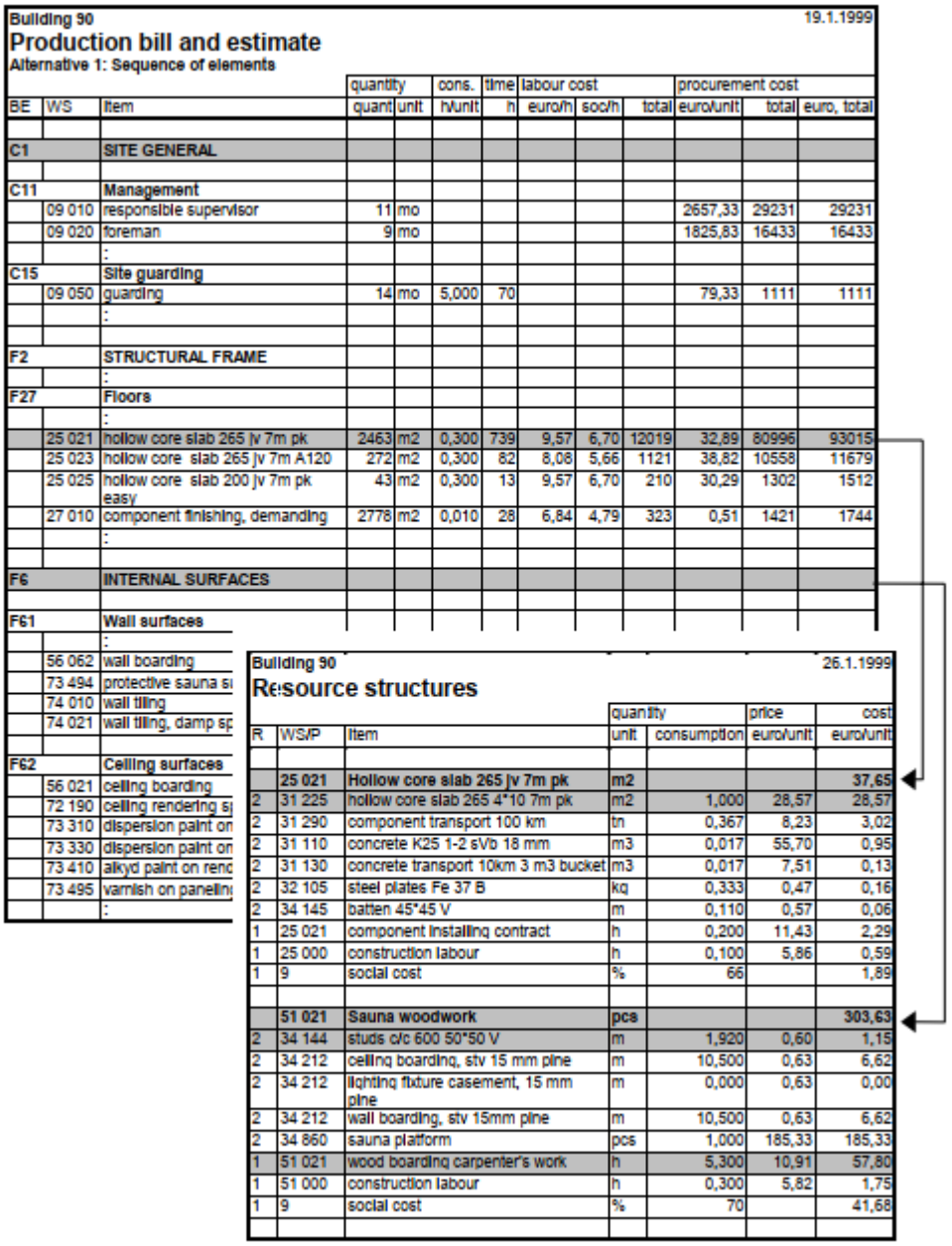


Fig 30. Two alternatives of production bill and estimate. (Talo 90 -1999)

As can be seen in Fig. 30, the price of the project, the cost estimation is based on the element, material, human resources, component required for the project.

In contrast, another alternative is the production bill and estimate based on sequence of work sections. (Talo 90-1999)



Building 90 19.1.1999

Production bill and estimate

Alternative 1: Sequence of elements

BE	WS	Item	quantity quant	unit	cons. h/unit	time h	labour cost euro/h	soc/h	total	procurement cost euro/unit	total	euro, total
C1		SITE GENERAL										
C11		Management										
	09 010	responsible supervisor	11	mo						2657,33	29231	29231
	09 020	foreman	9	mo						1825,83	16433	16433
		:										
C15		Site guarding										
	09 050	guarding	14	mo	5,000	70				79,33	1111	1111
		:										
F2		STRUCTURAL FRAME										
		:										
F27		Floors										
		:										
	25 021	hollow core slab 265 jv 7m pk	2463	m2	0,300	739	9,57	6,70	12019	32,89	80996	93015
	25 023	hollow core slab 265 jv 7m A120	272	m2	0,300	82	8,08	5,66	1121	38,82	10558	11679
	25 025	hollow core slab 200 jv 7m pk easy	43	m2	0,300	13	9,57	6,70	210	30,29	1302	1512
	27 010	component finishing, demanding	2778	m2	0,010	28	6,84	4,79	323	0,51	1421	1744
		:										
F6		INTERNAL SURFACES										
F61		Wall surfaces										
		:										
	56 062	wall boarding										
	73 494	protective sauna si										
	74 010	wall tiling										
	74 021	wall tiling, damp sp										
F62		Ceiling surfaces										
	56 021	ceiling boarding										
	72 190	ceiling rendering sy										
	73 310	dispersion paint on										
	73 330	dispersion paint on										
	73 410	alkyd paint on rend										
	73 495	varnish on panelling										
		:										

Building 90 26.1.1999

Resource structures

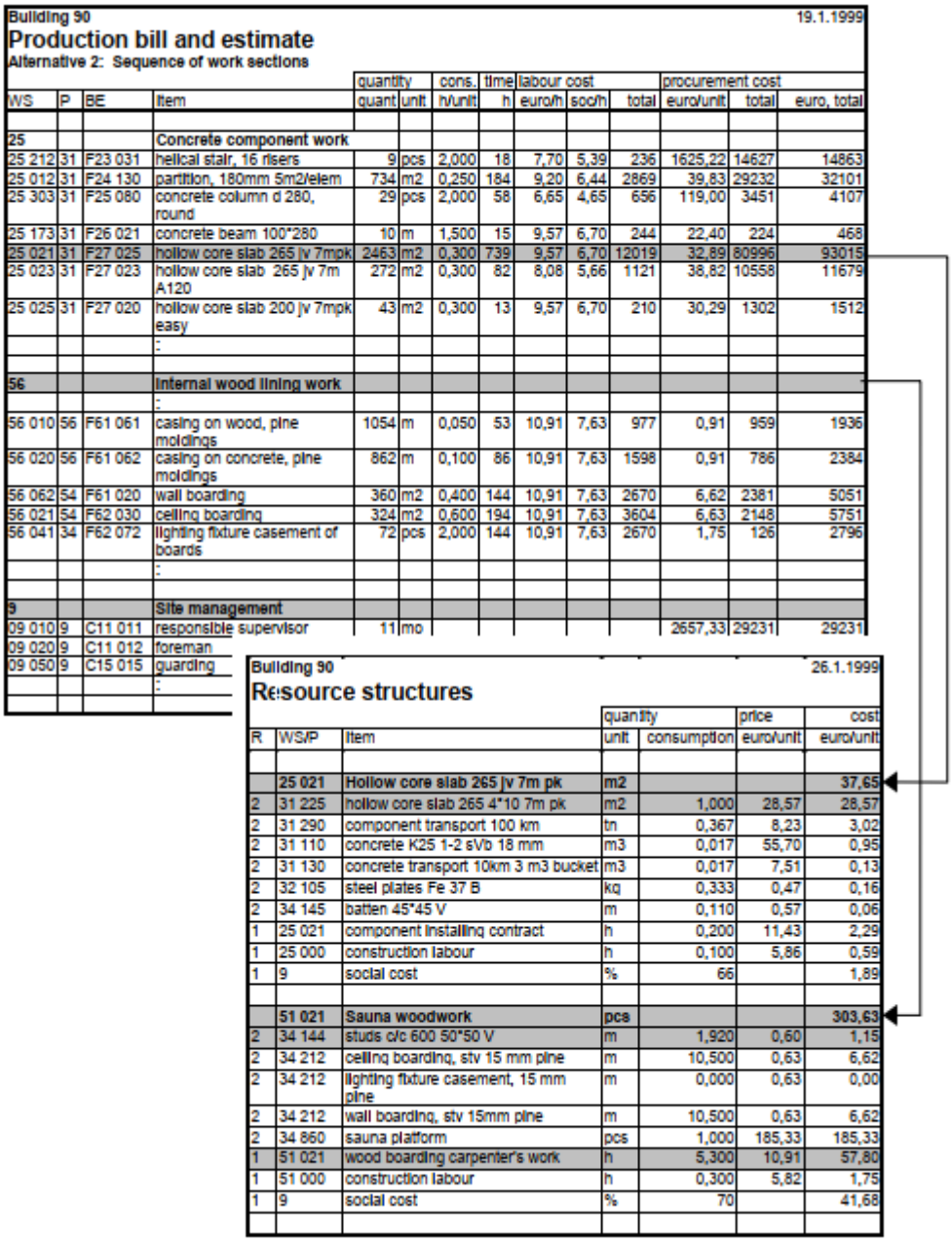
R	WS/P	Item	quantity unit	consumption	price euro/unit	cost euro/unit
	25 021	Hollow core slab 265 jv 7m pk	m2			37,65
2	31 225	hollow core slab 265 4*10 7m pk	m2	1,000	28,57	28,57
2	31 290	component transport 100 km	tn	0,367	8,23	3,02
2	31 110	concrete K25 1-2 sVb 18 mm	m3	0,017	55,70	0,95
2	31 130	concrete transport 10km 3 m3 bucket	m3	0,017	7,51	0,13
2	32 105	steel plates Fe 37 B	kg	0,333	0,47	0,16
2	34 145	batten 45*45 V	m	0,110	0,57	0,06
1	25 021	component installing contract	h	0,200	11,43	2,29
1	25 000	construction labour	h	0,100	5,86	0,59
1	9	social cost	%	66		1,89
	51 021	Sauna woodwork	pcs			303,63
2	34 144	studs c/c 600 50*50 V	m	1,920	0,60	1,15
2	34 212	ceiling boarding, stv 15 mm pine	m	10,500	0,63	6,62
2	34 212	lighting fixture casement, 15 mm pine	m	0,000	0,63	0,00
2	34 212	wall boarding, stv 15mm pine	m	10,500	0,63	6,62
2	34 860	sauna platform	pcs	1,000	185,33	185,33
1	51 021	wood boarding carpenter's work	h	5,300	10,91	57,80
1	51 000	construction labour	h	0,300	5,82	1,75
1	9	social cost	%	70		41,68

Fig 31. Production bill and estimate: sequence of elements. (Talo 90-1999)

The second altenative, presented in Fig. 31 is calculated based on work sections and products. The work section are broken down into products.

The unit cost in each table is calculated by breaking down the product structure into production structure., into work sections and further into resources of products, labor and site equipment.

The contractor estimates the tender by using either elemental estimate or the production schedule and production estimate. (Talo 90-1999)



Building 90 19.1.1999

Production bill and estimate

Alternative 2: Sequence of work sections

				quantity		cons.	time	labour cost			procurement cost		
WS	P	BE	Item	quant	unit	h/unit	h	euro/h	soc/h	total	euro/unit	total	euro, total
25			**Concrete component work**										
25 212	31	F23 031	helical stair, 16 risers	9	pcs	2,000	18	7,70	5,39	236	1625,22	14627	14863
25 012	31	F24 130	partition, 180mm 5m2/elem	734	m2	0,250	184	9,20	6,44	2869	39,83	29232	32101
25 303	31	F25 080	concrete column d 280, round	29	pcs	2,000	58	6,65	4,65	656	119,00	3451	4107
25 173	31	F26 021	concrete beam 100*280	10	m	1,500	15	9,57	6,70	244	22,40	224	468
25 021	31	F27 025	hollow core slab 265 jv 7mpk	2463	m2	0,300	739	9,57	6,70	12019	32,89	80996	93015
25 023	31	F27 023	hollow core slab 265 jv 7m A120	272	m2	0,300	82	8,08	5,66	1121	38,82	10558	11679
25 025	31	F27 020	hollow core slab 200 jv 7mpk easy	43	m2	0,300	13	9,57	6,70	210	30,29	1302	1512
			:										
56			**Internal wood lining work**										
			:										
56 010	56	F61 061	casing on wood, pine moldings	1054	m	0,050	53	10,91	7,63	977	0,91	959	1936
56 020	56	F61 062	casing on concrete, pine moldings	862	m	0,100	86	10,91	7,63	1598	0,91	786	2384
56 062	54	F61 020	wall boarding	360	m2	0,400	144	10,91	7,63	2670	6,62	2381	5051
56 021	54	F62 030	ceiling boarding	324	m2	0,600	194	10,91	7,63	3604	6,63	2148	5751
56 041	34	F62 072	lighting fixture casement of boards	72	pcs	2,000	144	10,91	7,63	2670	1,75	126	2796
			:										
9			**Site management**										
09 010	9	C11 011	responsible supervisor	11	mo						2657,33	29231	29231
09 020	9	C11 012	foreman										
09 050	9	C15 015	guarding										
			:										

Building 90 26.1.1999

Resource structures

			quantity		price	cost
R	WS/P	Item	unit	consumption	euro/unit	euro/unit
	25 021	**Hollow core slab 265 jv 7m pk**	**m2**			**37,65**
2	31 225	hollow core slab 265 4*10 7m pk	m2	1,000	28,57	28,57
2	31 290	component transport 100 km	tn	0,367	8,23	3,02
2	31 110	concrete K25 1-2 sVb 18 mm	m3	0,017	55,70	0,95
2	31 130	concrete transport 10km 3 m3 bucket	m3	0,017	7,51	0,13
2	32 105	steel plates Fe 37 B	kg	0,333	0,47	0,16
2	34 145	batten 45*45 V	m	0,110	0,57	0,06
1	25 021	component installing contract	h	0,200	11,43	2,29
1	25 000	construction labour	h	0,100	5,86	0,59
1	9	social cost	%	66		1,89
	51 021	**Sauna woodwork**	**pcs**			**303,63**
2	34 144	studs c/c 600 50*50 V	m	1,920	0,60	1,15
2	34 212	ceiling boarding, stv 15 mm pine	m	10,500	0,63	6,62
2	34 212	lighting fixture casement, 15 mm pine	m	0,000	0,63	0,00
2	34 212	wall boarding, stv 15mm pine	m	10,500	0,63	6,62
2	34 860	sauna platform	pcs	1,000	185,33	185,33
1	51 021	wood boarding carpenter's work	h	5,300	10,91	57,80
1	51 000	construction labour	h	0,300	5,82	1,75
1	9	social cost	%	70		41,68

Fig 32. Production bill and estimate. (Talo 90 -1999)

In the production estimation stage, the production solutions are chosen. These are used in the production schedule, which is priced using the resources price files. It might be arranged by either elements and work phases or by work sections. (Talo 90-1999)

Building 90 26.1.1999

Resource price file

R	WS/P	Item	unit	euro/unit
2	31 225	hollow core slab 265 4*10 7m pk	m2	28,57
2	31 280	hollow core slab 265 jv 7m A120	m2	34,51
		:		
2	34 144	studs timber 50*50 V	m	0,60
2	34 160	studs timber 19*95 V	m	0,54
2	34 125	studs timber 50*100 V	m	0,87
		:		
1	25 021	component installing work	h	11,43
1	51 021	wood boarding carpenter's work	h	10,91
		:		

Fig 33. Resources price file (Talo 90 -1999)

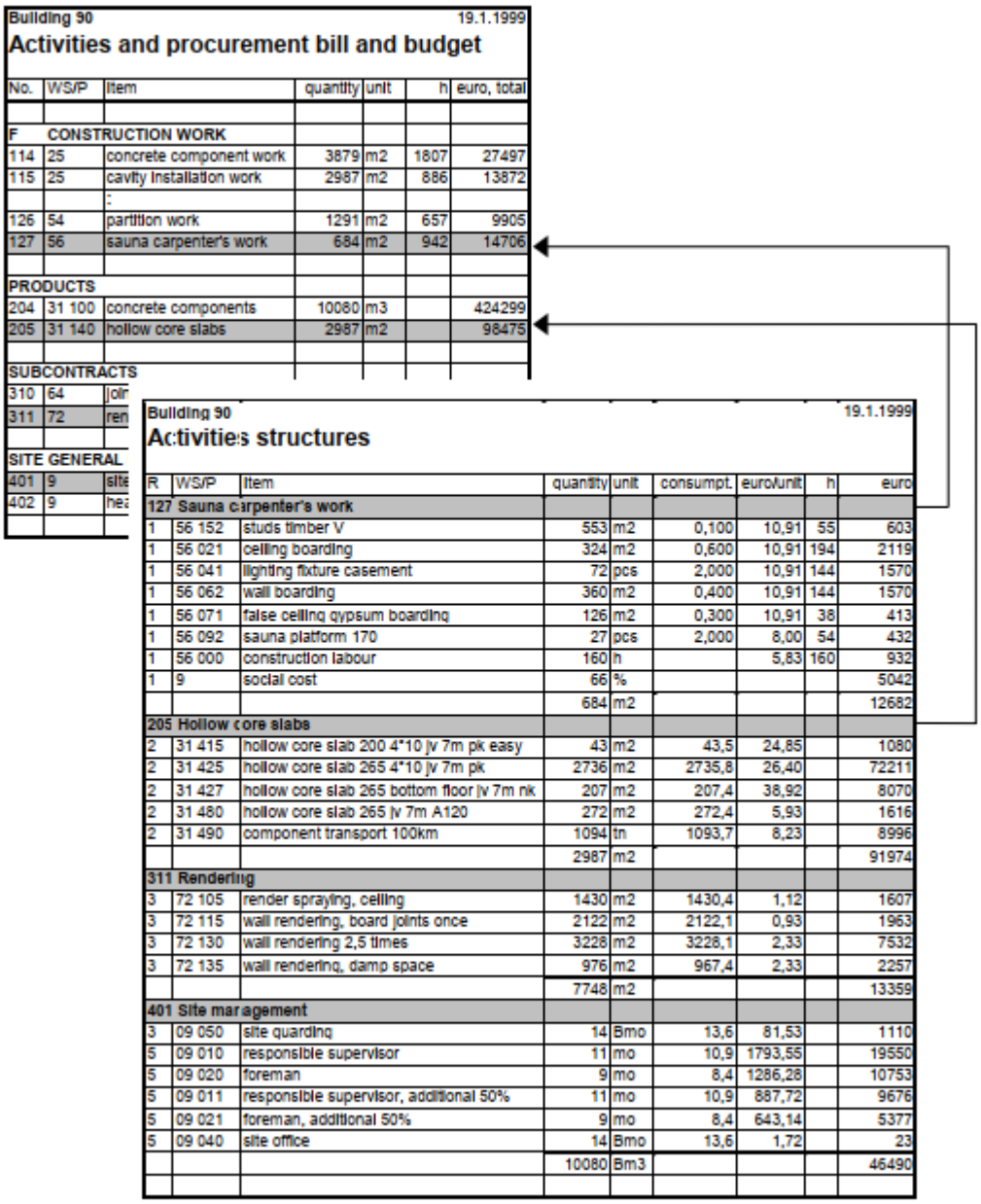
Once the production estimation stage is finished,the production bill need to be considered. Production bill is based on each company-specific resources structure, priced according to continuously updated resources price file. The items are classified by both elements and work sections of Building 90 classification tables.

For the planning purpose, control, supervision and avoiding fraud during the process, the production estimation is regrouped into activities bill and budget. The activities bill consists of labor work activities, procurement activities and general site activities. The objective of each activity is different and each activitiy is numbered in order to keep track, keep the project going on schedule without delaying.

The activities and procurement bill and budget will help the supervisors, counsellors, workers as well as engineers to keep track with the work, so that the work can proceed as scheduled. With this estimation, price of each category, expenses of each work section will be elaborated further.

According to Building 90 activity control method, every activity is planned and calculated before execution and the estimated expense of the plan shall be lower than the target price. In the same way, every procurement bill should be lower than the target price in order to

ensure that the controlling measures precede the start of work or the purchase order. (Talo 90-1999)



Building 90 19.1.1999

Activities and procurement bill and budget

No.	WS/P	Item	quantity	unit	h	euro, total
F	CONSTRUCTION WORK					
114	25	concrete component work	3879	m2	1807	27497
115	25	cavity installation work	2987	m2	886	13872
		:				
126	54	partition work	1291	m2	657	9905
127	56	sauna carpenter's work	684	m2	942	14706
PRODUCTS						
204	31 100	concrete components	10080	m3		424299
205	31 140	hollow core slabs	2987	m2		98475
SUBCONTRACTS						
310	64	join				
311	72	ren				
SITE GENERAL						
401	9	site				
402	9	hea				

Building 90 19.1.1999

Activities structures

R	WS/P	Item	quantity	unit	consumpt.	euro/unit	h	euro
127 Sauna carpenter's work								
1	56 152	studs timber V	553	m2	0,100	10,91	55	603
1	56 021	ceiling boarding	324	m2	0,600	10,91	194	2119
1	56 041	lighting fixture casement	72	pcs	2,000	10,91	144	1570
1	56 062	wall boarding	360	m2	0,400	10,91	144	1570
1	56 071	false ceiling gypsum boarding	126	m2	0,300	10,91	38	413
1	56 092	sauna platform 170	27	pcs	2,000	8,00	54	432
1	56 000	construction labour	160	h		5,83	160	932
1	9	social cost	66	%				5042
			684	m2				12682
205 Hollow core slabs								
2	31 415	hollow core slab 200 4*10 jv 7m pk easy	43	m2	43,5	24,85		1080
2	31 425	hollow core slab 265 4*10 jv 7m pk	2736	m2	2735,8	26,40		72211
2	31 427	hollow core slab 265 bottom floor jv 7m nk	207	m2	207,4	38,92		8070
2	31 480	hollow core slab 265 jv 7m A120	272	m2	272,4	5,93		1616
2	31 490	component transport 100km	1094	tn	1093,7	8,23		8996
			2987	m2				91974
311 Rendering								
3	72 105	render spraying, ceiling	1430	m2	1430,4	1,12		1607
3	72 115	wall rendering, board joints once	2122	m2	2122,1	0,93		1963
3	72 130	wall rendering 2,5 times	3228	m2	3228,1	2,33		7532
3	72 135	wall rendering, damp space	976	m2	967,4	2,33		2257
			7748	m2				13359
401 Site management								
3	09 050	site guarding	14	Bmo	13,6	81,53		1110
5	09 010	responsible supervisor	11	mo	10,9	1793,55		19550
5	09 020	foreman	9	mo	8,4	1286,28		10753
5	09 011	responsible supervisor, additional 50%	11	mo	10,9	887,72		9676
5	09 021	foreman, additional 50%	9	mo	8,4	643,14		5377
5	09 040	site office	14	Bmo	13,6	1,72		23
			10080	Bm3				46490

Fig 34. Activities and procurement bill and budget. (Talo 90-1999)

4.3 Quantity and Condition survey in Finland

In Finland, condition and quantity survey comprises these basic stage cost steps:

- Tender bids
- Production costs

- Production planning
- On site costs
- Maintenance costs

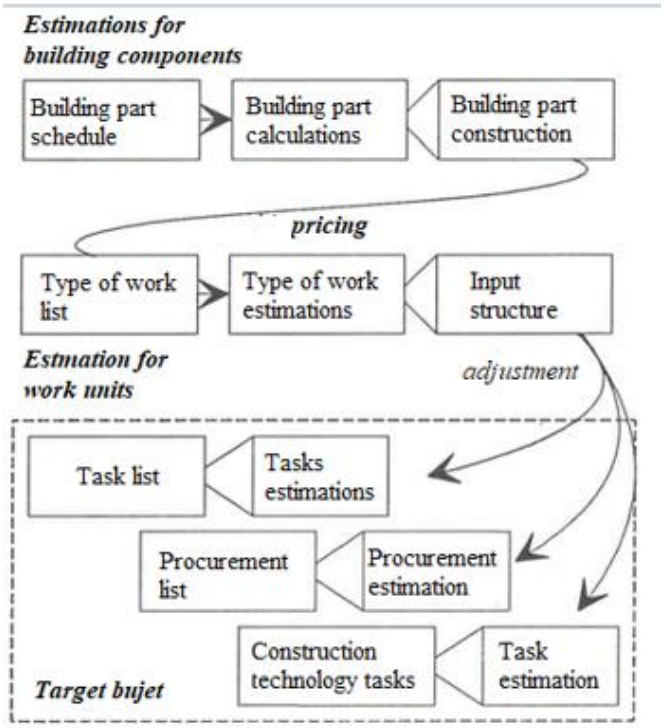


Fig 35. The process of producing the quantity survey for the construction management costs. (Talo 90-1999)

In the estimation for building components, the main purpose of the quantity survey is to indicate the quantity required in the projects, and the price that each unit might cost.

In the estimation for work units, the function of the condition survey is to obtain a site goal estimate, also target for job labels.

Quantity and condition survey calculation includes calculating the items to be used for the project (the item being for example the amount of concrete, the amount of steel…). These items are formed and estimated since the beginning of the project, from the starting point of task planning and/or work site purchasing package including:

- Foundation: pad footing, ground work, Plinths, frost insulators
- Ground floor: Fillings, radon drains, heat insulation, tiles
- Exterior walls
- Partition wall

- Upper floor: the amount of concrete needed for slab, the amount of steel needed for the slab
- Facades, etc.

Unit of measurements: the unit of measurements are mainly categorized for the nature, shape and size and for making payments to the contractor and also.

The principles of units measurements normally comprises of the following:

- Single unit such as doors, windows, trusses and similar character material are expressed in numbers of quantity.
- Work involves measurements in length such as hand rail is expressed in running meters.
- Work consists of areal surface measurement involving area like plastering, partitions etc.., are expressed in squared meter. (m^2)
- Work consists of cubical contents such as concrete work, masonry etc., are expressed in Cubic meters. (Talo 90-1999)

4.3.1 Rules for measurements

Rules for measurement should be made in order to keep track of material, as well as avoiding faulty and fraud.

First rule: Measurements shall be made for finished item of work and description of each item shall include materials, transportation cost, labor, fabrication equipment and plant and all types of overheads for finishing the work in required shape, size and specification

Second rule: In booking, the order of booking shall be in sequence of length, breadth and height or thickness

Third rule: all works should be measured subject to the following tolerances:

- Linear measurements shall be measured to the nearest 0.01m
- Areas shall be measured to the nearest $0.01m^2$
- Cubic contents shall be worked out to the nearest $0.01m^3$

Fourth rule: Same type of work under different conditions and nature shall be measured separately under separate items.

Fifth rule: The bill of quantities shall fully describe the materials, proportions, workmanships and accurately represent the work to be executed

Sixth rule: in case of masonry (stone or brick) or structural concrete, the categories shall be measured separately and the height shall be described:

From foundation to plinth level

From plinth level to first level floor

From first floor to second floor level and so on. (Talo 90-1999)

4.4 Factors affecting project cost in Finland

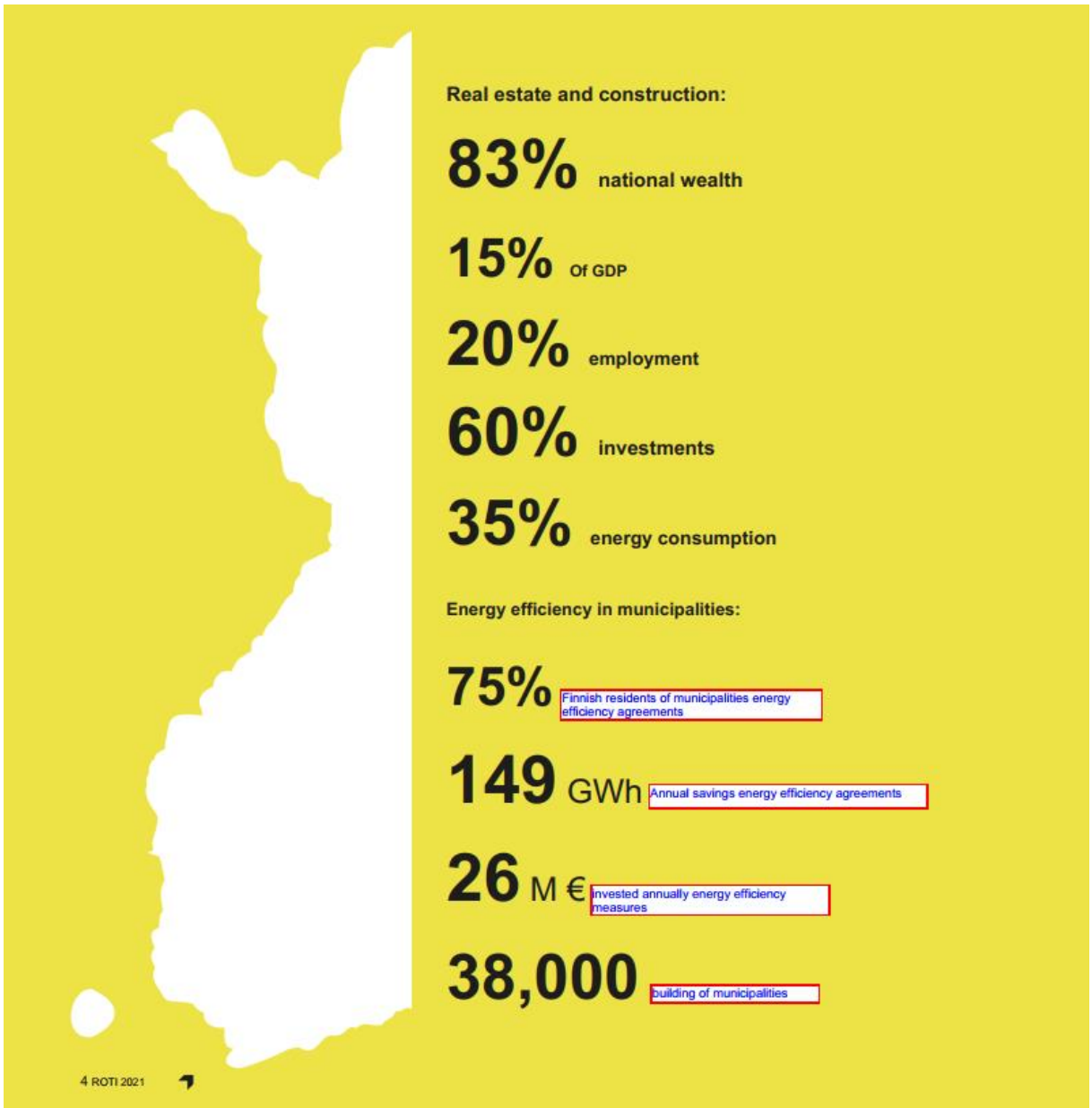


Fig 36. Construction figure in Finland according to Roti. (ROTI, 2021)

As Roti indicates, Construction industry plays an important role in Finland's total GDP as well as the nation wealth.

Based on research by Statistics Finland, building costs have risen by 1.1% in February 2021 compared to the situation a year earlier. Labour costs went up by 1.2% and costs of materials by 1.3%.

So many factors, including direct and indirect factors can affect the cost of a project. (Talo 90-1999)

These problems can be briefly indicated as:

- Human labour work: since the population of Finland is just 5.5 million in total, workers are always needed in construction site in Finland. The amount of foreign workers also comprises a large amount of workers in total. One problem with foreign workers is that they need to be qualified to work as a construction worker, in addition, they also need to study the Finnish language in order to communicate on site, which will take time for them to do.
- Weather condition: in spite of having a good atmosphere and one of the cleanest air in the world, the long winter may slow the construction process, which affects the whole cost of the project.
- Material: Finland has a great source of wood material and considered "the Lung of Europe", which will provide construction industry a large amount of wood for building. This leads to a cheaper price of wood material in construction industry.

5 Comparison between Vietnam and Finland

5.1 Same principle and definition

With project cost, the definition of project cost, role of project cost and phases of project cost between the two countries are the same. Every project needs a cost estimation, as well as the project cost management in order to see if the project will be economically efficient

or not. As a result, the basic principles, basic roles and basic characteristics of project cost are the same between Vietnam and Finland.

In addition, every project needs approval for a building permit, for a project to be executed, paper works need to be done with steps, based on each country's regulation.

5.2 Different parts in project cost

5.2.1 Difference in cost estimation

In both countries, Vietnam and Finland, the cost estimation is assessed and planned with respect to the items of work, the amount of material and the construction cost to be used in the projects. However, there are some differences between these categories and how to evaluate the building cost. In Vietnam, the cost estimation is based on the total weight after condition survey, the total amount of work estimated and price of each work.

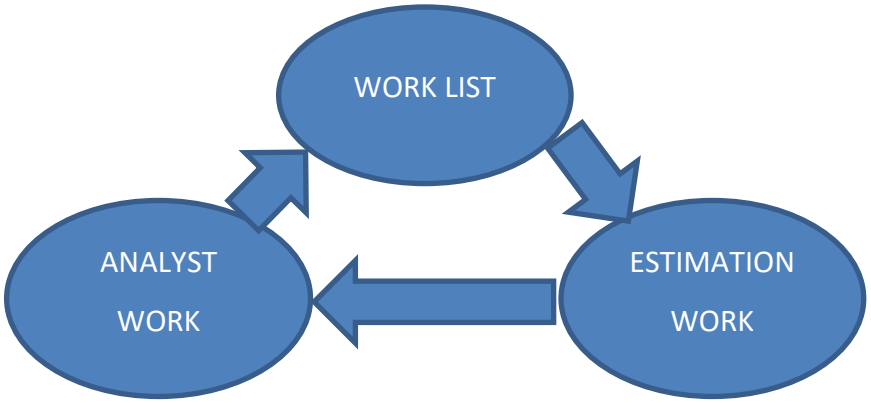


Fig 37. Cycle of a project

However, in cost estimation in Finland, the purpose of each room has to be elaborated. For the pharmacy considered in the case study, the cost estimation of the total area with Finnish Talo 90 would be:

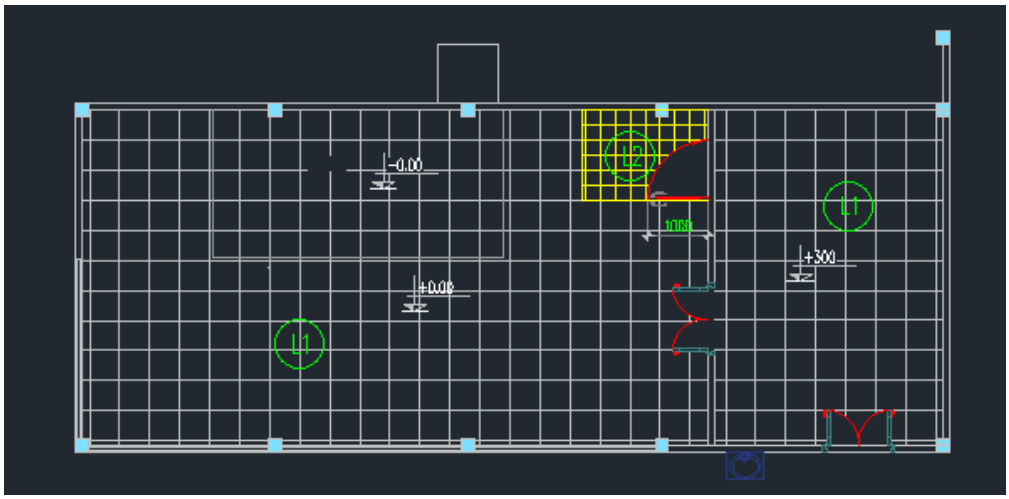


Fig 38. Cross-section of the case study.

Space destination	Area
Total area	82m^2
2 rooms + 1 kitchen	

As in Talo 90, the price for 2 rooms will be cheaper than 3 rooms, because the total cost for building is based on the amount of rooms and theirs function. In Vietnam, the total cost estimated is not based on the number of rooms and the function of each room, it is based on the total area for the project to be built on the land used for the project.

With regard to material cost, with Talo 90, the amount of material needed for each area will be indicated for that area only, the amount of components will be elaborated for that component only, all costs related to the components and material will also be indicated in the same sheet. By contrast, in Vietnam cost estimation on material will all be shown in the same page, same Excel sheet, not considering the properties of the material and the price related.

	Ordinal number	Name of material	Unit	Total amount	Finishing price
4	1	1x2 stone	m3	56.12	2020546
5	2	30*30cm Ceramic Brick	pieces	41.6	5108103
6	3	400x400mm Brick	m2	19.46	1752030
7	4	4x6 stone	m3	7.5	257783
8	5	600*600mm	m2	119	196425
9	6	Cement	kg	179	528694
10	7	Cement PC30	kg	1298	240179
11	8	Cement PCB40	kg	822	3071941
12	9	Electric wire 1x1, 5mm2	m	192	934758
13	10	Electric wire 1x2, 5mm2	m	204	1734000
14	11	Nail	kg	81.6	19000
15	12	Natural granite	m2	14.45	3078349
16	13	Paint	kg	13	1062720
17	14	PVC plastic water pipe D25, L=6m	m	28.2	185093
18	15	PVC plastic water pipe D40, L=6m	m	12	
19	16	PVC plastic water pipe D75, L=6m	m	20	
20	17	Sand	m3	58	1852643
21	18	Screw nails	pieces	502	
22	19	Sink	pieces	1	4050000
23	20	Smooth Sand ML=0.7 / 1.4	m3	3.5	42282
24	21	Smooth Sand ML=0.7 -1.4	m3	32.8	854116
25	22	Structural steel D<=10mm	kg	4078	16354373
26	23	Structural steel D<=18mm	kg	4600	17104594
27	24	Toilet	pieces	1	2524000
28	25	Water	liters	857	17138
29	26	Water	liters	22463	348187
30	27	White cement	kg	15	
31	28	Yellow sand	m3	33.8	

Fig 39. Cost estimation plan of material for the case study, conducted by the Vietnamese estimation system.

Fig. 39 shows the cost estimation rendering the material, as it is done according to the Vietnameese system. The currency of the cost estimation is in Vietnamese Dong (1 Euro= 27.500VND).

By the Finnish system (Talo 90), this estimation would be totally different. The pharmacy should be divided into 2 rooms and 1 bathroom (no kitchen) and the cost estimation should be based on the characteristics of each element and each type of work.

Space requirment			
Requirements	Unit	Value	Commentaries
2 room + Bathroom			
1 Measurement and form			
room area	m2	82	
width*depth	m2	14.05*5.8	
floor to floor height	m2	4.09	
room height	m2	4.09	
2 Interior climate			
Temperature control	C	from 20 to 26	Keep cool to store medicine Air conditioner required
Humid control			depends on season
3 Sound insulation			
Partition wall	dB		
Premise entry doors	dB		

Fig 39. Space requirement in planning stage.

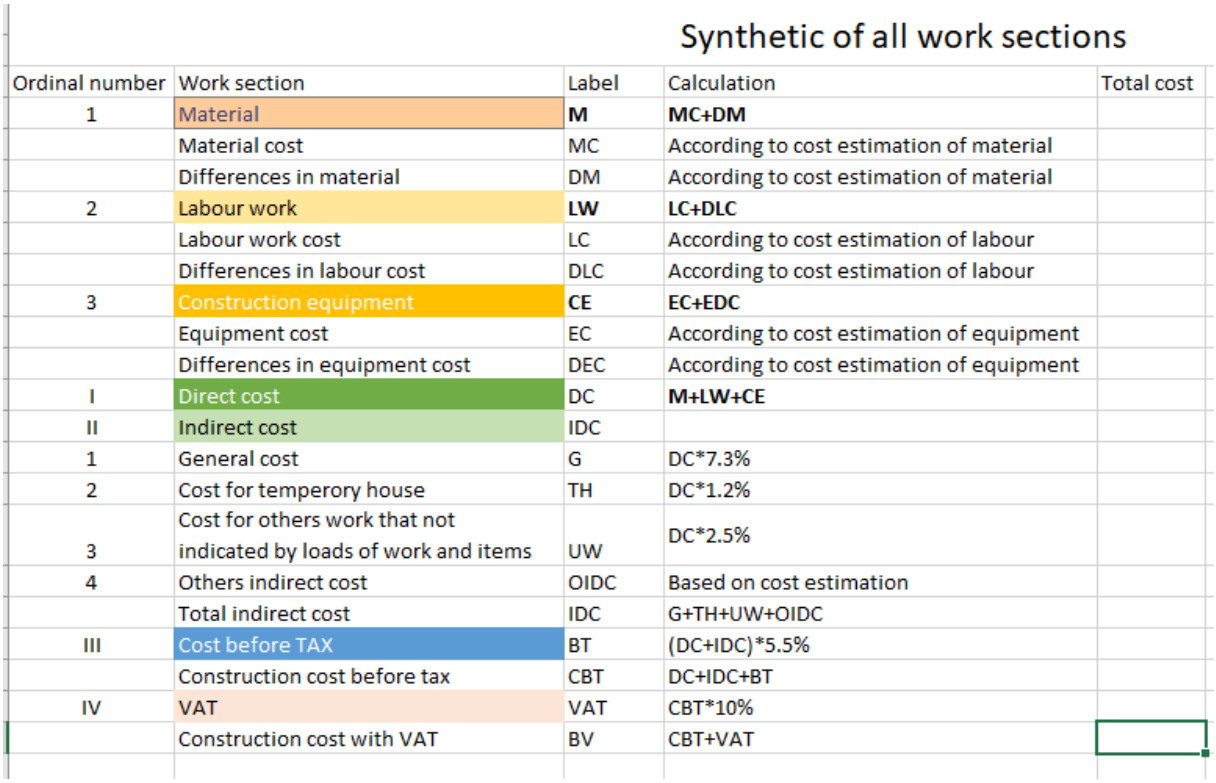
The difference can clearly be seen in the table from Fig. 40. With Talo 90, more requirements and more specification need to be clarified.

Elemental bill and estimate				
	Quantity	Unit	Euro/unit	Euro/Total
Structural frame elements				
Beam	7	piece		
Column	10	piece		
Foundation bracing	6	piece		
Floor slab				
Slab structure with d18 steel	2	slab		
Internal surface				
2 rooms + 1 bathroom	82	m2		
Internal equipment				
All internal equipmet (including funiture, water pipe and electric system)				17781

Fig 40. Elemental bill and estimate

With the Vietnamese cost estimation, all work, materials and labour work will be synthetized in one big table. All works sections, material and human labour would be elaborated in

different tables. Regarding the case study, the summary of all work sections can be seen in Fig 41



Synthetic of all work sections

Ordinal number	Work section	Label	Calculation	Total cost
1	Material	**M**	**MC+DM**	
	Material cost	MC	According to cost estimation of material	
	Differences in material	DM	According to cost estimation of material	
2	Labour work	**LW**	**LC+DLC**	
	Labour work cost	LC	According to cost estimation of labour	
	Differences in labour cost	DLC	According to cost estimation of labour	
3	Construction equipment	**CE**	**EC+EDC**	
	Equipment cost	EC	According to cost estimation of equipment	
	Differences in equipment cost	DEC	According to cost estimation of equipment	
I	Direct cost	DC	**M+LW+CE**	
II	Indirect cost	IDC		
1	General cost	G	DC*7.3%	
2	Cost for temperory house	TH	DC*1.2%	
3	Cost for others work that not indicated by loads of work and items	UW	DC*2.5%	
4	Others indirect cost	OIDC	Based on cost estimation	
	Total indirect cost	IDC	G+TH+UW+OIDC	
III	Cost before TAX	BT	(DC+IDC)*5.5%	
	Construction cost before tax	CBT	DC+IDC+BT	
IV	VAT	VAT	CBT*10%	
	Construction cost with VAT	BV	CBT+VAT	

Fig 41. Synthetic of all work sections.(MAYBE SUMMARY)

Each work sections, material and labour work should be indicated in different tables in order to keep track of fraud and differences to see the efficiency of the project in both system.

5.3 Conclusion with comparison

The comparison of project cost estimation between the two systems can be seen in Table 5.

Table 5. Comparison between two countries

Comparison of cost estimation between two countries	
Vietnam	**Finland**
-The total cost estimation should comprise of work section, material, labour works and others related expenses. -Each category should be elaborated in different tables. -In the work section table, all work is listed, not based on material or component and types of work (such as concrete work, exterior work, etc.) -In the material table, all materials are listed (including HVAC infrastructure such	-Cost estimation should be made based on the space requirements of the whole project. -In each phase, different tables are needed -All related works (for example concrete work, interior work) is placed separately. -Interior design, exterior design, structural work are shown in different tables.

as water pipe, electric wire, switchers, ….). Material table is not based on which room the material will be installed and used. -In the labor work table, only workers' salary is indicated, since the work of supervisor, designer and engineer is signed in the working contract. -A resource file for price is based on the market price and each supplier's price, based on Vietnam regulation.	-The supervisor's salary is included in the production table. -A resource file for price is based on each company file, based on Finland's regulations.

So what are the advantages and disadvantages of each country's way?

The advantages and disadvantages in each country are shown in Table 6

Table 6. Advantages and disadvantages of each system.

	Advantages	Disadvantages
Vietnam	-Each category can be easily kept on track to check fraud. -The total cost estimation for a project can be easily seen in the tender and procurement phase. -Differences between planned and real expenses will be indicated.	-Work with the same characteristic cannot be seen (for example concrete work, interior work) is not clearly indicated. -In some cases, indirect cost can be taken advantages for own purpose, especially in undefined item work, meaning fraud can occur.
Finland	-Work with the same characteristics or work with the same room or structure can easily be tracked. For example, with concrete work of a slab, the missing amount of concrete can easily be detected. -Work section related to specific components or structure can be clearly indicated. -No fraud related to work section or material differences can take place.	-All material cannot be clearly seen. -All work sections cannot be clearly indicated.

6 Summary

The project cost plays an important role and is a crucial factor when evaluating whether a project will be economically efficient or not. The project cost should be estimated and optimized starting the first stage of the project and must be done for both the owner and

the contractor to see the amount of material needed and work criteria in order to keep track of the schedule of the project, as well as avoiding fraud during construction process.

However, the project cost can be affected by both direct and indirect factors. Some of the most crucial factors that might affect the whole cost of the project are human resources, design, material cost and risk cost.The salary paid to workers, designers and supervisors comprises a large amount of money during a construction project and should be considered carefully so that the project would not be in crisis because of human resources. The change of design is also a factors that make the cost of a project fluctuate if not agreed between the owner and the contractor at the fisrt meeting. The choice of material and construction cost and method should be determined within the budget of the whole project. Last but not least, a risk cost should also be taken into consideration, for example, on-stie accidents or inflation rate.

There are differences in the cost estimations between Vietnam and Finland. In Vietnam, the cost estimation is based on each of the following work criteria: work phase, material, human resources. In contrast, with Talo 90, the cost estimation in Finland is conducted by each room, each material section, human labour related to that material section. Each system has its own strengths and weaknesses. The Vietnamese cost estimation system would be more optimal with large, tall buildings and more suitable for bigger projects, whereas the Finnish way would be executed better with residential houses. The difference between the countries is based on each country’s regulation and the cost estimation program used.

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Appendix

Appendix 1: Applying for a building permit in Vietnam.

There are two kinds of budget in a project in Vietnam: government budget and private budget. In each kind, the procedure for a building permit would be different.

Private budget

-Investor requests construction site from Department of Construction, or Ministry of Construction of the city where the project will be executed, in order to see the land is in plan of the city or not.

-Assumed being approved, investors shall hire a design counselling team, plan the project consist of: basic design, total area for the project, total estimated cost for the project.

-With the project with the total cost smaller than 15 billion VND (equal to 550.156 euros), investor conduct the one-phase file request (make a Economical-Technical Report), submit to Department of Construction to calculate and evaluate. If satisfied and approved, Department of Construction give permission to start the project.

-With the project bigger than 15 billion VND (equal to 550.156 Euros), investors have to submit to the Ministry of Construction for calculation and evaluation.

-Investors submit paper works to Department of Architecture and Planning to see the feasibility of the project.

-With enviromental related project (hospitals, water sources related project, waste related projects, etc.) the investors need to submit paper work to Department of Natural resources and Enviroment or Ministry of Natural resources and Enviroment to evaluate whether the projec would harm the enviroment or contaminate the water source or not.

-After being approved about method, total area and total budget for the project, investors need to mobilise capital, escrow from the bank to conduct the project.

-After being officially approved with paper work, the construction process can start after 2 months since the day of approval.

Government budget.

-The govermemt evaluate whether the project is feasibe with the planning of the whole city or not.

-Submit paper work to the authorise to approve the method in which the project would be conducted.

-After the project is approved, with the project less then 15 billion VND (550.156 Euros), investors make a Economical-Techincal Report.

-With the project larger than 15 billion VND (equal to 550.156 Euros), the investors need to conduct two-phase project:

+phase 1: create a basic design, basic cost estimation.

+phase 2: submit to the Ministry of Construction to evaluate.

-After being approved by either Minsitry or Department of Construction, with the projcet budgeted smaller than 15 billion VND(550.156 Euros), investors shall be able to start the project.

-With the project with the budget larger than 15 billion VND (550.156 Euros), Investors submit fundamental design and detail cost estimation. After being approved, the investors can start the project.

Appendix 2: Applying for a building permit in Finland.

Applying for a building permit in Finland.

The process of applying for a building permit in Finland can be seen in Fig.1.

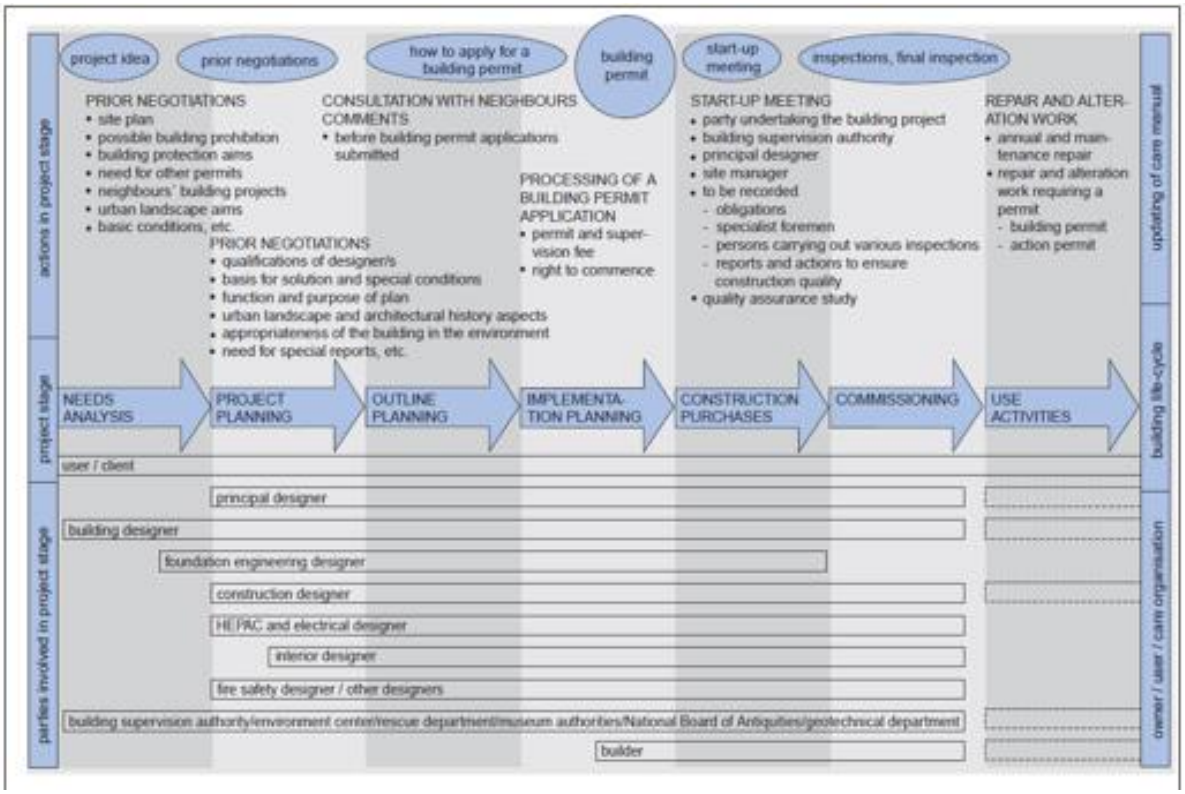

Fig 1. Process of applying for a building permit in Finland.

Conditions for a building to be permitted to build in a local detailed plan areas:

-Project complies with valid local detailed plan.

-General conditions of the building site:

+No building prohibition in force.

+The plot is not planned and registered for building already.

+Historical or Architectural values affecting the project should be taken into consideration.

+Removal of polluted land.

+Water supply and water waste system should be connected to the plot area.

+Usable access to the building site.

-Construction complies with the valid local detailed plan or has been granted deviation.

-The building is appropriate for the site.

-A functional access road to the building site already built or will be built in the future.

-Water supply and water waste system should be arranged so as not to harm the environment.

-Building should be constructed so as not to harm the neighbors or neighbors' properties.

According to LUBA section 123, a building permit is needed for:

- Construction of a building.
- Repairs and alterations of a building.
- An extension to a building.
- Repairs and alterations that can affect the health and safety conditions of the person using the building.
- A major change in the using purpose of the building.

Alterations requiring a building permit:

- A material changes of use.
- Repairs and alterations affecting health and safety conditions of person using the building.
- An alteration that increases the building floor area.
- Bathroom extension and similar.
- Significant alterations to the façade.

Permit Procedure:

1. The application for a building permit:
    - Applications can be obtained from the Internet and from the land use and environmental service point.
    - Signed by the owner of the building and the project.
    - The other signatory must have a power of attorney from the applicants.
    - Designers' name, training and contacts.
    - Appointed principal designer and his contact information and signature.
2. Proof of ownership of tenure of a building site:
    - A copy of the lease agreement or
    - A copy of the sale contract and sellers' title.

- A building permit map.

3. Land Map/Official map mark:
    - An extract from the base map of the area or from the local detailed plan, acquired from the service point of the National Land survey of Finland.
4. Extract from Finnish Trade Register.
5. Master drawings:
    - 3 sets of master drawings, in 1:100 and 1:50 scale.
    - 3 sets of building site layout, in 1:500 or 1:1000 scale.
6. **Additional documents:**
    - RH 1 building project notification must be filled separately for each building to be constructed.
    - RH 2 Apartments notification- only if the project contains more than one apartment.
    - RK 9 – Demolition plan
7. **Outside colors:**
    - Templates available in the Building Office or online.
    - Façade colored drawing.
8. **Pre-authorized and statements if any**
    - Environmental impact assessment
    - Notification sent to the neighbors.
    - Landscape work permit.
    - Need for planning and deviation.

Applying for a building permit can take from 6 to 8 weeks, depending on work situations, congestions and public holidays.

During the waiting time, the plots that are going to be used can be used for building works, such as peeling topsoil or bring the building block to the plot.

Construction work must not commence until the building permit decision is authorized and officially approved.

The appeal period for the decisions is 14 days and the decisions of the board 30 days.

The Building Inspection Office must be notified of the commencement of work.

Notification can also be performed directly at the start-up meeting