Expertise
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Wille Nurmi

Operating room design process (tech.)

From the view of building design

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Designing a new operating room is a complex and long process. The design of operating rooms must consider structures (walls, doors, windows etc.), technology (ventilation, electricity, automation etc.) and user expectations (functional design). Combining all of these brings challenges to the process. When designing operating rooms for a new building, the process is also long lasting and usually takes up to several years, as the design of the operating rooms goes within the building design schedule. As a result, when operating rooms are completed, they may no longer serve the best possible need of present.

The aim of the research was to explore how the current operating room design process looks like when building design process is used as the reference process. The study also addressed the design process comparison from the perspective of the traditional implementation of the operating room and the modular / turnkey operating room.

This study was conducted to address standard or universal operating room. Hybrid or other operating room with special purposes was not considered in this study.

The quantitative study was carried out conducting an internet survey and the data was collected from experienced technical hospital designers and medical professionals.

Results showed that the design process is not clear, and it varies according to the type of project. There seems to be almost as many design processes for the operating room as there are type of projects, designers, end users, and builders. The type of construction project affects the design process and the clear boundary seems to be very volatile between certain design stages, e.g. proposal design and general design. According to the results, it can only be estimated whether the design and principle decisions of something is made at the beginning or towards the end of the project. On a rough level most of the design and principle decisions seems to be made in early stages of the project, either project planning, proposal design or general design phase.

Comparison of the traditional way of operating room implementation and modular / turnkey operating room design process revealed that it is very similar in most of the technology areas.

Keywords	operating room, hospital, design, design process, building design

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1 Introduction

The existing hospitals in Finland, as in most parts of Europe, are mainly built in the 60’s and 70’s and no longer serve the current technologies and operating models. As a result, existing hospitals are widely either being renovated or replaced completely by new buildings.

The construction, renovation and extension of hospitals is a unique opportunity significantly revamping hospitals operating models and processes. Investing in a new hospital or repairing an existing hospital is usually one of the area's largest construction projects. When renovating a hospital, priority must be given to service delivery and its quality, availability, productivity, and cost. New productivity gains in service delivery and cost management can cover the entire real estate investment during the hospital life cycle (Nordic Healthcare Group 2016).

Surgeries and operating room usage can provide up to 60% of hospitals total revenue and is usually very critical. Operating room time is also very expensive, when the cost can be as highs as 75 € a minute. The high costs of operating rooms motivate to design better and high productivity operating room solutions (Cochran & Li & Vanover & Foley 2016).

No perfect operating room has yet been made and surgeons complain about their work environment every now and then. Most companies who provide their solutions for operating rooms, strives for the best possible product or solution design for surgeon, nurse, patient and the administration. Just talking about how to design the perfect operating room is much easier than actually doing one. Technology has been the driver in design of operating rooms, and now days, when very modern operating rooms are designed, the devil is in the details (Kavic 2001).

1.1 Background

Today, businesses are constantly under pressure of developing new business models in order to reach the increasingly demanding market where customers are more demanding and new competitors are coming from all the way around the world. Businesses no days need constantly be able to adapt to changing customer needs so that they can

generate as much value as possible to the customer, which should be the added value that the customer is willing to pay for. Most technology companies focus very hard on building new innovative products and solutions, but at the same can forget that elegant products and solutions does not automatically change into a successful business. Businesses now days require an equally elegant business model with the right price, message and delivery channel to the right target customers.

Halton Group Ltd. Is a Finnish family owned technology company which among other things, manufactures ventilation and environmental control systems for operating rooms and other demanding healthcare and cleanrooms. This study was made to improve Halton operating room solutions and services to meet even better the needs of customers and designers in the future.

2 Conceptual framework for the study

I was interested to looking into operating room design process, because when I have been working with designers and end users considering operating room design, the commonly used design process in general was unfamiliar to me, and also at Halton. I had also heard from different stakeholders that the design process itself takes usually very long time and can cause some issues in when finalized. Operating rooms may not serve the operation in the best possible way because the design is based on outdated data. The preliminary idea of this topic came out of my personal experience and discussions I had with my colleagues and customers.

Very few studies or researches could be found regarding operating room design process, either in Finland or on a European scale. For this reason, the theoretical part also briefly addressed hospital design.

Sources used in this study were mainly scientific articles and literature available online and in the library. The keywords used when defining the source material were operating room design, operating room, hospital design and building design process.

This study was conducted to address standard or universal operating room. Hybrid or other operating room with special purposes was not considered in this study.

Figure 1. Standard Operating Room (Halton 2018)

2.1 Operating room design

Whether it is about building a new or renovating an operating room, design and implementation can be very challenging. Although materials are available for the selection of operating room equipment, floor plans, and other solutions, it is still difficult to determine your own solutions and future needs. A clear understanding of the needs of the future is already a big step towards a successful project (Tomaszewski 2008).

Bringing together a competent and multidisciplinary design team is the first step towards a successful project. The group should consist of e.g. users (surgeons, nurses, anesthetists / nurses), maintenance, procurement, hospital engineers and technical designers. In addition, you need to be accompanied by an architect who creates the plan and infrastructure to support overall design. A well-coordinated operating room design team provides the best starting point for a successful operating room project. Planned scheduling and operating room planning also provides a good starting point for a project accomplished on budget and on schedule. Successful system implementation and planning also requires an interdisciplinary team that works closely with suppliers from the beginning, like suppliers of lighting, ventilation, endoscopic products etc. (Tomaszewski 2008).

Well-designed and functional operating room usually requires 2-3 years and well coordinated teamwork. The design should always start from the goal date, and work from that point backwards, so that important milestones in the planning are clear as early as possible. To be safe, suppliers should always be given at least 6 months to design, deliver and install their solutions. That leads to that room design and technical designs should be ready at least 6 months before the desired operating room handover date. As is known, a change in an architectural design on the initial meters of paper may cost few hundreds, while an architectural change in the final phase of the design or in the implementation phase can cost tens of thousands. Last-minute changes are very expensive and time-consuming, and should be avoided by good design, scheduling, and teamwork. Today’s operating rooms must also be flexible for us much cases (operations) as possible, so that the usage of operating room is on high efficiency level as possible (Tomaszewski 2008).

2.2 Operating Room, traditional implementation

When referring to traditional operating room implementation in this study, means it traditional way designing and building and an operating room complex. The responsibility is on multiple suppliers, including design, wall, ceiling and floor structures, doors, windows, building services and validation measurements. Customer and/or designer are responsible for the detail design, project management and for the whole.

2.3 Operating Room, modular / turnkey

Modular operating room, or turnkey operating room, which came to the market as an alternative for traditional operating room construction, was introduced as early as the 1950s, by the French company Veller. The walls and ceiling of the hall were prefabricated at the factory, and its equipment was built inside the walls. Veller's modular operating room was marketed as a complete product and included operating room equipment. Later in the 1950s, British surgeon Denis Melrose at Hammersmith University in London designed a prefabricated operating room in collaboration with the engineering firm New Electronic Product, the company was later acquired by Honeywell Controls. The rationale for designing such a new operating room was the high number of hospital infections in traditional operating rooms. In the early 1960s, the first modular operating room was

installed at Hammersmith Hospital, and by 1968, 65 modular rooms had been sold (Hughes 1981).

The first modular solutions had a lightweight frame to which modular panels were attached. The panels were laminated with a melamine surface and the inside filled with polystyrene. The frame of the panels was made of wood. The walls were fastened to each other with tight mechanical locks. The first modular operating rooms were octagonal in plan. The triangular halls were thought to be smoother in terms of airflow and easier to clean. At that time, doctors, nurses, engineers, and architects praised the modular operating room. In the 1960s, however, the disadvantage of a modular operating room was considered to be its high cost (Hughes 1981).

Today, a lot of modular operating rooms are being built around the world. In particular, modular cleanroom elements are typical solutions in Europe and North America. However, modular operating rooms, cleanroom elements, and turnkey deliveries to operating rooms appear in the Finnish market also, but they have not been that popular because it has been proved to be expensive compared to traditional implementation. There has now been a change in the recent years due to,

- new standardization regarding operating rooms (pressure to design and build better quality)

- previously modular operating rooms on the market consisted mainly of walls and medical devices, now building services technology has become stronger. Perhaps the main focus now is on the walls and building services technology

- the amount of technology is increasing constantly. In traditional implementation, problems have been found in fitting the technologies into a compact package (collisions occur and are resolved during the installation phase). The total delivery of the operating room is a way to manage the construction risk and costs for the client

- large public projects have become interested in modular operating rooms and have carried out tenders (to accommodate their budgets), which has increased supply and pushed down prices on the market

(Sokolnicki M. 2020)

When referring to modular/turnkey operating room in this study, means it an operating room complex under the responsibility of a single supplier including project management, detail design, wall, ceiling and floor structures, doors, windows, building services and validation measurements. One supplier is responsible for the whole.

2.3.1 Modularity

Definition “Modularity” refers to the simplification of a complex product, system, process or organization by assembling it into defined subsystems (product parts, components and modules), the interfaces between which are as loose and standardized as possible. Modularity enables the product partitioning into more manageable components (e.g. product part) that can be designed and produced independently of each other and connected to the final product through predefined interfaces (Työterveyslaitos 2018).

A module can be internally complex and integrate many functions and components, but the connections between modules are instead simplified. The modular solution can be designed to meet the specific needs of the customer by uniquely combining different components that produce specific functions. However, at the same time a standardized component or module can be produced in large quantities for a variety of customer end products, enabling economies of scale in production (Työterveyslaitos 2018).

In construction, modularity typically refers to the modularity of a product or space, although the modularity of a construction process or organization can also be considered. Organizational modularity is usually a reflection of the modularity of a product, i.e., a loose and modular product allows for a loose and decentralized organization (Työterveyslaitos 2018).

2.3.2 Modular – Turnkey Operating Room content

A typical modular operating room usually consist of walls, doors, windows, lighting, monitors, cameras, pendants, ventilation system, gas systems etc., however, the content can

often vary widely depending on the project. A modular operating room, also called a turnkey operating room, usually includes also detail design, project management and warranty services (Sokolnicki M. 2020).

In figure 2 can be seen typical content of a modular operating room delivery.

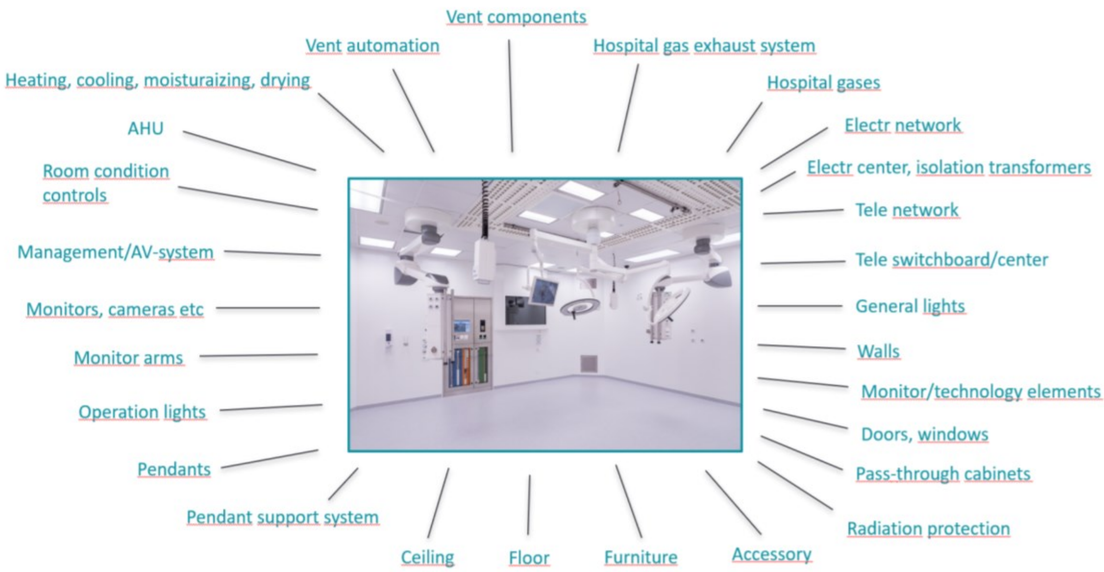

Figure 2. Content of a typical modular operating room delivery (Halton 2018)

2.4 Hospital design

The main challenges in hospital design is the design tradition and loss of know-how. New hospital projects stopped in the 1980's and no hospital project planning or management experience is required from educated architects or hospital physicians or nurses. This easily leads to a building project like many other construction projects; needs assessment, project planning, technical design and construction work are done in different stages, each of which is the responsibility of a person who has never been before in hospital project of this magnitude (Nordic Healthcare Group 2016).

Currently, three different groups are responsible for the design of hospitals:

A. end users, who represents medical expertise and hospital
B. funders and decision makers, who must be convinced of the need for the project
C. designers and the architects, who's tasks have become two-fold, when one of the groups takes into account the functional part, financial and reality, and the second group focuses on the functionality and usability of the building.

The expertise of groups should be combined in the design process, so that the overall picture would be visible all the time.

Naturally, the expertise of different groups of actors focuses on different stages, but it is important to keep all key players and areas of expertise constantly involved in the design process, internalizing the basic concepts of service production planning. Below is a simplified description of the current and goal-oriented design process with various stages of planning and their content (Nordic Healthcare Group 2016).

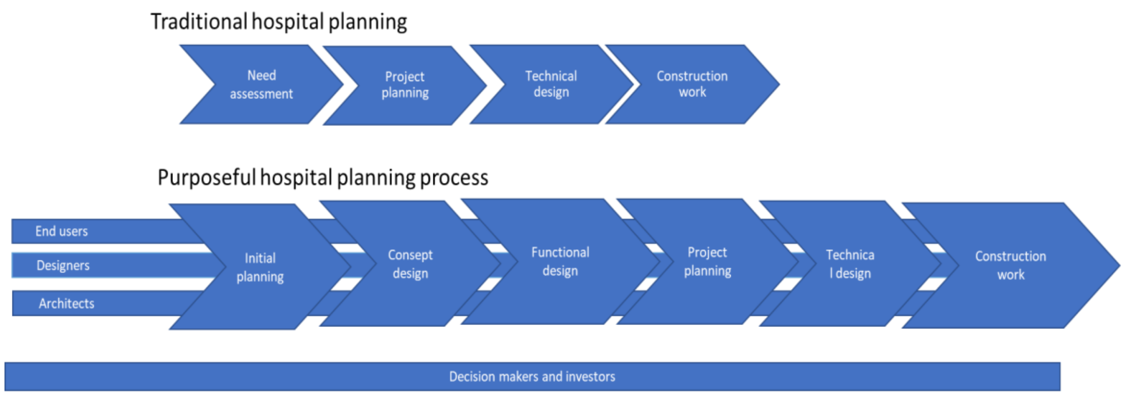

Figure 3. Hospital design process and its project groups

2.5 Building design and execution process

Breakdown of a construction project is the key for project management. Segmentation is the process of dividing a project into smaller entities that can be used to better manage and control the project. The breakdown describes the whole project and how its components are interlinked technically, operationally, on schedule, in terms of costs and responsibilities. Typically, a construction project is subdivided in different ways, depending

on the stage of the project and the party involved. Construction publications, such as to-do lists, construction nomenclature, and house costing publications, provide various ways of subdividing a project. When making a division, note that different subdivisions affect each other and the entire construction project (Rakennustieto 10-11224 2016).

The “Rakennustieto”, which is the official Finnish building standards, shows the progress of a building project (Rakennustieto 10-11224 2016), were the progress of a construction project is divided into different phases so that the preparation of the design, the acquisition of a building permit and the preparation of construction are not treated as separate phases. In the task list for project management and construction, the HJR12 model instructs to divide the projects into 11 different phases, which are constituted based on of the task entities included in the project (Rakennustieto 10-11107 2013).

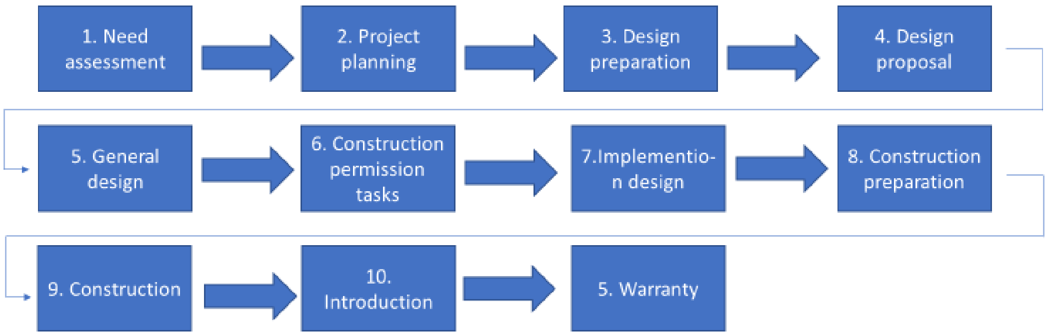

Figure 4. The progress of the construction project

The construction project is managed by the client or an external operator selected by the client for the task. The client always has certain tasks and decisions in the project that he has to make in order for the construction project to proceed. HJR12-assigment list is defined building and construction management tasks in such a way that the person initiating a building project, and the same party chosen by construction management experts are aware of their responsibilities and the boundaries between (Rakennustieto 10-11107 2013).

The project is usually sequenced in successive phases. Phasing facilitates management decision-making. There is no commitment to decisions that are too weak and, if necessary, a follow-up plan can be re-evaluated at the end of the phase. It may be that, for

example, the project needs to wait for funding for the next phase between stages (Pelin 2011: 63 - 66).

Within each phase, the project is divided into parallel subprojects. These are subdivided into subprojects etc. depending on the size of the project. The smallest element of the project delivery structure is the so-called. work package, which includes detailed tasks. At the end of each step, a clear measurable result is produced. The result can be clarification, specification, prototype, etc. The composition of the project team can change significantly between stages (Pelin 2011: 63-66).

At each stage of the project, there are several stakeholders involved in the project with their own tasks. Construction involves different tasks that can be organized in many ways. The tasks result in design documents, decisions of the project or authorities, and construction work. Respective the decisions made at the end of the phase are aimed at solutions that provide a framework future phases and parties of the project. Decisions taken during the early stages of a project, may also give up or postpone the implementation of the project (Kankainen & Junnonen. 2015: 12-15).

2.5.1 Project planning

Once the project decision has been made, the construction project proceeds to the project planning stage (Rakennustieto 10-11107 2013). The starting points for project planning include, among other things, the preliminary space program prepared in the need assessment, the characteristics of the facilities and the planned implementation schedule. The status program and other input data are specified in the project planning phase as a planning guide for building design. In the project planning phase, more precise criteria and objectives related to the scope, quality, costs, schedules, and maintenance of the property are presented. In addition, in the project planning phase, the construction site and the method of project implementation are determined. The parties involved in the project design phase are usually the owner and user of the building, the builder and the designers. As a result, an investment decision is made in the project planning phase on the basis of the approved project plan, the aim of which is to be in balance between the initial data and the project objectives (Kankainen & Junnonen 2015: 20).

The starting point for project planning is to set goals for building design, especially for the design schedule and costs. Depending on the need and target, designers from different fields can also be involved in the project planning phase. The actual building design will start at a later stage, but the possibilities and costs of different solutions will be explored with the precision of the preliminary building design. When comparing different cost factors and solution possibilities, one may end up with, for example, a result that requires a change of formula or a larger plot. Conclusions on different solutions and cost factors can be varied, for example, when the scope is insufficient, efforts can be made to reduce the previously defined program or to change the plot or property. Design at the project design stage is preliminary design and comparison of alternatives, final decisions on the different alternatives are made only at the draft design stage. Project planning aims to refine the needs assessment and create a guide for designers, whose goals and criteria are used by designers to design a building. The tasks of the project planning phase also include setting the budget and specifying the scope of the user's activities and its dimensioning (Kankainen & Junnonen 2015: 20).

The main task of the end user in the project planning phase is to define the functions taking place in the building and their needs. The builder works in project design as a construction professional and is responsible for the content and progress of project planning.

When designers are involved in the project planning phase, their job is to obtain and compile input data for building design. The most important task of an architect in project planning is to draw up a space program. The space program presents all the spaces that are assumed to be included in the building. The space program usually lists at least the titles, numbers and areas. It is essential for the success and preparation of the status program that the user has been able to describe his activities to the required extent. When drawing up the space program, the characteristics of the structures that affect the operation of the spaces are also determined. Functions can affect, for example, room height, sound insulation, lighting, indoor climate, electrical solutions, surface materials, and furniture and fittings (Kankainen & Junnonen 2015: 20 - 21).

If the function differs from the so-called normal operation, the space program can be supplemented with room cards. Spaces that deviate from normal operations and impose special properties on structures and buildings can be, for example, various production

facilities, operating rooms or laboratories. The initial data for such facilities will be provided by the user, in which case this preliminary information should be reviewed with an expert in the field at this stage so that the designers and other parties involved in the project have an idea of the technical level and cost of the facilities (RIL 2013: 159 - 160).

In small and clear projects, need assessment and project planning can be done at the same time, and as a result, a project plan can be directly generated. This will speed up the preparation phase and saves resources and costs. An important part of the project planning phase is the analysis of the site and conditions, as well as various decisions. Without explanations, no decisions can be made and without decisions, the project cannot be taken forward. Thus, in the project planning phase, precise decisions are made to start the planning phase (RIL 2013: 159 -160).

The purpose of project planning is therefore to form a jointly set goal and provide answers to the questions of what is being done, why, when and at what cost. The project plan serves as a design guide for subsequent design phases and is the first document to describe the project. (RIL 2013, p. 159-160) The result of project planning is an investment decision, which is conditional on a procurement plan approved by the parties (Rakennustieto 10-11107 2017).

2.5.2 Design preparation

After the investment decision, project building design can begin. Design is based on achieving the best possible quality within the resources provided. The success of a construction project is important, as design solutions have a significant impact on the project economy (Rakennustieto 10-11107 2017).

The preparation of the design begins when the project plan has been approved and the investment decision has been made. In the design preparation phase, design is organized and the procurement process for designers is carried out and planning is started. The builder acquires the designers and enters into design contracts, approving the decisions made at each stage according to the contract with his client. As a result of the design preparation, a design decision is made, after which the design work can be started (Rakennustieto 10-11107 2017).

The draft design goes through the baseline design information defined in the project planning phase. At this stage, the project plan is checked for functionality and the design is reviewed. In addition, the project features and objectives for technical solutions and systems will be explored, under the direction of the customer or principal designer detailed planning schedule (Rakennustieto 10-10827 2004).

2.5.3 Proposal and general design

In the proposal design phase, alternative design solutions are created according to the objectives set for the project. In order to meet the set objectives of the project, proposal design requires guidance, which must take into account among other things, functional, economic, aesthetic, technical, environmental and other requirements in accordance with the objectives (Rakennustieto 10-11107 2017).

The design team previously selected in the proposal design prepares various building implementation solutions, from which the client is presented with the proposal selected by the design team as the most suitable for approval. The result of the proposal design is the first total solution of the building, which serves as the basis for the next design phase, general design. Proposal design can be done already in the earlier stages of the project, such as in the project planning phase, for example in solving various details. As a process, proposal design can be considered independent of the project phase. Larger and more complex projects have recognized the importance of leveraging creative and innovative design at the earliest possible stage of the project (RIL 2013: 162 - 163).

Concept design is a form of proposal design that is utilized in conjunction with or alongside project planning and needs assessment. In concept design, various new solution models are sought to assemble functional processes into a building. Usually, concept design looks at reference sites, creates analyzes of project needs, presents different space solutions, examines cost factors and implementation methods, and takes a stand on issues related to life cycle, energy and sustainable development (RIL 2013: 162 - 163).

A master plan is prepared based on the proposal plan approved by the client. The purpose of the master plan is to develop the selected proposal plan into a viable plan (Rakennustieto 10-11107 2017). In building design, a building is often divided into a fixed and a variable part (RIL 2013: 162 -163). The fixed part of a building includes the physical

parts of the building that are assumed to remain unchanged even if the building undergoes changes during construction and operation. The fixed part may include, for example, fixed spaces, such as lobbies and toilets, as well as fixed frame and building technology components, such as facades and structural components defined by spans (RIL 2013: 162 - 163).

Variable parts of a building include spaces that may change their purpose or use, such as various spaces in commercial and office buildings. Preparations are made for changes to the premises during both the construction and operation phases. (Saari 2010). If the division of the building into fixed and variable parts is successful, it will be possible to change the division of space in an even later implementation planning phase. The aim of the general design is to commit to the fixed parts of the building and to present a proposal for the changing parts of the building. The proposal plan is specified in the general design phase to the extent that the quality level of the building can be determined with the accuracy required by the implementation costs. In general design, the chief designer, architect, and other special designers ensure the route possibilities of different systems, considering the fixed and variable nature of the building section. In general design, it is also common to produce various calculations, prepare a construction report and do product part design (RIL 2013: 164).

2.5.4 Implementation design

In implementation design the master plan is developed into dimensioned plans and product specifications required for construction and procurement (Rakennustieto 10-11107 2017). The documents to be drawn up at the design stage include working drawings and technical plans based on which the quantity and quality of the building can be unambiguously determined for the purpose of submitting a tender (Kankainen & Junnonen 2015: 20-22).

Implementation design can be divided into two parts, one is the preparation of plans related to the contractor selection phase and the other is the preparation of plans during construction (RIL 2013: 164-165).

The method of implementation chosen for the project will affect how much detailed plans are needed at any given stage. For example, with the traditional form of procurement

(traditional total contract), complete work drawings are required for the contractor selection phase, so that most of the design takes place before the start of the work and planning during the work is minimal. Another example of a form of procurement is project management contracting. In this form of procurement, the contractor can already be selected with preliminary plans and the work will start overlapping with the general design. In this case, design during construction is paramount (RIL 2013: 164-165).

2.5.5 Forms of construction projects and contracts

The form of contract refers to the way in which the contractual structure of the parties to the construction project is organized. The form of the contract has a key effect on the contracts and responsibilities of the company ordering the work. The most used forms of construction projects are listed below.

General contract (FI: Kokonaisurakka), is the most traditional of the contract forms. In the general contract, the contracting authority enters a construction contract with one contractor and the contractor carries out the construction work based on documents prepared by the contracting authority. In principle, the contracting authority is responsible for the information in the design documents in relation to the construction contractor. In general contracting, the contractor is responsible for the construction work as a whole. This clarity of layout is one of the strengths of the form of contract, since when a client orders construction work from a single contractor, it avoids taking part in the contractual relations and liability arrangements between the construction contractor and its subcontractors (Kiinteistölehti 2015).

Design and build (FI: SR, Suunnittele ja Rakenna), also known as a total liability contract (FI: KVR). The form of contract is also called a turnkey contract, because in this form of contract, the contractor both designs and carries out the actual construction work. Even in Design and Build contracting, a company that orders construction work has in principle one contract partner who performs the construction work. However, unlike in a traditional general contract, the design in the D&B contracting are not the responsibility of the client. The contractor's liability in the D&B contract is thus broader than the traditional general contracting (Kiinteistölehti 2015).

Shared contract (FI: Jaettu urakka), means that the contract is split into lots and divided into several contractors. In a shared contract, the builder enters into different works contracts with several contractors for the shared contract. A shared contract usually has

a main contractor whose job is to do the civil engineering work, with the execution of the special work being left to the subcontractors. The builder assumes the risk that the actions of different contractors will cause damage to another contractor (Kiinteistöoikeus 2018).

Subordination of a side contract (FI: sivu-urakan alistaminen), a subordinate contract subordination procedure has been developed to help manage the shared contract. This refers to a procedure and contract in which contracts awarded in the name of a company that has ordered different work from different contractors are subordinated to a contractor appointed as the main contractor by a separate subordination contract. The main contract is generally defined as the work of the contractor responsible for the main work of the building complex (Kiinteistölehti 2015).

Project Management contract (FI: Projektinjohtourakka), a separate project management organization replaces the main contractor. The organization may include individuals from the developer and project management contractor organizations. In the project management contract, the contractor takes care of the developer's and construction site tasks as well as the main contractor's work (Kiinteistöoikeus 2018). The customer always has the final word on design and procurement (Kiinteistölehti 2015).

Alliance contract (FI: Allianssiurakka), the term alliance generally refers to an alliance of actors and an agreement aimed at combining objectives and / or activities. For a specific project matching the corresponding arrangement is called project alliance or an alliance contract. An alliance contract is a form of project implementation based on a common agreement between the main actors of the project, in which the parties are jointly responsible for the planning and construction of the project to be implemented in a joint organization, and where the actors share both the positive and negative risks associated with the project and adhere to the principles of transparency of information with a view to establishing close cooperation (VTT 2009).

None of the contract forms is automatically better than the other, but the client must choose the contract form considering the features and objectives of the project (Kiinteistölehti 2015).

3 Context of the study

Operation room design process is usually long lasting and complex, considering the rapid changes in technology development and the change of needs. In some cases, operating rooms which are finalized, are based on need assessments and solutions which are made several years before. When completed may not serve the best possible needs of present.

This study addresses the process of a construction project according to the HJR12 assignment list. The study reviews the design stages 2, 3, 4, 5 and 7 shown in Figure 4.

The purpose of this Master Thesis is to increase knowledge and practical experience about operating room design process, when using building design as a reference process.

Specific objective was to find out answers to following questions,

1. What is the design process of a standard operating room compared to building design process in general?

2. How does the design process differ when comparing modular/turnkey and traditional operating room?

3.1 Materials and methods

When considering the type of research methodology, I started with familiarize myself with the literature dealing with the topic.

Purpose of quantitative research is either to explain, describe, map, compare, or predict human characteristics or behaviors (Vilkka 2007: 19). My research purpose was to map and compare the views of different experts on the commonly used design process of operating rooms, so the quantitative research was chosen as research methodology.

The working method was an explorative study, which is used especially when little previous information is available on the topic under study. With the help of explorative research, the source material can be used more widely. In an explorative study can be found in the subject key models, themes, and categories (Vilkka 2007: 20).

According to Dr. Dawson (2002: 15), quantitative research generates statistic through a use of survey research, using methods as questionnaires. A closed questionnaire is best suited when you want to get statistical attributes in a study. The responses of the questionnaire can be converted to numerical format and entered directly into computer software for analysis (Dawson 2002: 15).

In a questionnaire format the questions are standardized, which means that all the questions are asked from participants in same order and in the same way. The respondents him- or herself reads the question and answers it. The questionnaire is used when the observation unit is a person that concern him or her, such as opinions (Vilkka 2007: 28).

I decided to collect the data by an internet survey questionnaire.

3.2 Population and sampling

As I continued planning my research project, the next step was to determine the respondents to participate in the study.

Operating room design is a very marginal and special design industry in general, so it was clear to me that there are only a relatively small amount of people with professional in Finland who can give the best and most realistic answer to my survey questions.

For this reason, I decided to choose a smaller and manageable number of people to take part in this research, which is called sampling (Dawson 2002: 47). When I knew in this stage that the sampling group will be quite small, I decided to contact all the participants available in advance to get the answering rate as high as possible. When crosstabulation between groups are wanted, it is better to have as much as possible of participants (Dawson 2002: 49).

I decided to do the purposive sampling according to my own knowledge regarding operating room professionals which I knew from my work life history. I started make calls to some professionals and asked if they want to participate in my research, and if they could give contact details to other professionals, they knew in the field of operating room design. I also asked several colleagues within the company if they knew customers and partners who are experts in current field. This type of purposive sampling is called snowball sample (Dawson 2002: 50).

I made my decision based on the discussions I had with my instructor from work, that the people who were invited to participate in this research was done by following.

The person participating in research must be,

- HVAC designer (Hospital)

  or

- Electrical designer (Hospital)

  or

- Project Manager (Hospital / operating room project)

  or

- Other professional who has participated in an Operating Room project group

  or

- MD or other medical professional who has participated in an Operating Room project group

3.3 Data collection

There are healthcare professionals and designers in Finland who are currently or have recently been involved in major hospital and operating room projects, which have been a trend in Finland for a while already. The individual participants were invited for the research on basis of calls I made to different hospital operating room professionals and hospital consultants/designers.

The data collection part was started by contacting people personally from designer/consultant companies and hospitals. The result of these contacts gave me contact details and permission to send the invitation to totally 30 operating room professionals, of which 26 invited were working with operating room design, project supervisor or other technical duties, and 4 with MD or other medical background relating to operating room design and implementation.

Data collection was done by web-based survey with close ended questions, and it included an introduction of the survey topic, purpose, and general information (can be found as app. 1). The participants had also possibility to leave a free comment at every question. Answering period was defined to 1 week and during this time two reminders were sent.

The survey questions were defined together with Halton Health sales & project management team. The questions are based on experience from delivered turnkey operating room projects.

When drafting the questions, we kept in mind that the questions are not introductory, are short and clear, are not in any way negative or confusing, and that there is a clear answer to all the questions (Dawson 2002: 90).

The survey was conducted so that it was possible to choose only one of the options.
The respondent was also given the opportunity to answer “I cannot say” for each question related to the design of operating rooms if that area of design was not familiar to the respondent.

In the first part of the survey were questions about participant knowledge and experience related to operating room design. This phase was very important for the study because

the information was needed in the study reliability assessment phase. The second part of the survey were related directly to operating room design process and its phases.

A pre-test survey was sent as test round to few colleagues in Halton Health -team, and a partner, operating room design professional outside of Halton organization. The final survey questions were modified based on the test survey comments received. The survey questions can be found as appendix 1.

3.4 Data analysis

In quantitative research, the collection of research data, the processing of research data, and analysis and interpretation are separate steps. Processing of the material begins when the material collected through a survey has been compiled. Data processing means that the data obtained with the forms are checked, the data are stored in a computer format that can be examined numerically with the help of spreadsheet or statistical programs (Vilkka. 2007: 106).

Research material was reviewed and collected when survey deadline had expired. Information and assess quality of the responses was checked immediately and went through question by question. No inappropriate forms or errors could be found. The collected data was analyzed by using Excel and SPSS.

The analysis part was started by evaluating participant data. According to results (chapter 4.1), all respondents were selected to the analysis phase.

The results of questionnaires were entered to an observation matrix table. The horizontal row of the observation matrix contains the data of all variables of one respondent, the observation unit. The vertical columns are equal relevant information from all observation units. This information varies with different observation units.

In the analysis of research question 1, all respondents were included in the analysis. Survey answer option “I cannot say”, was defined as missing information, but it was included in the analysis part but treated as their own class. In the analysis of research question 2, when comparing traditional and turnkey implementation, the missing information “I cannot say”, was ignored in SPSS analysis phase.

According to Vilkka (2007: 119), the method of analysis is chosen according to whether one variable or the dependence between two or more variables and the effect of the variables on each other are being studied. If the goal is to get information about the distribution of one variable, location numbers are used. Location numbers refer to key figures that describe the location of observational values. The most common location numbers are average and mode. When the goal is to analyze the relationship between two variables, cross-tabulation shall be used.

In this study, the modes of the results provide answers to the research questions. If the mode is “shared” between two or more answering options, it can be concluded that the result, decision of specific survey question, is unclear and/or can be decided in different design phases depending on OR project.

When comparing two proportions and the sample size is small, we can estimate possible data combinations and calculate it as exact P-values. In this type of cases the nominal level of statistical significance (P-value less than 0,05) can be defined with the Fisher’s exact -test (University of Sheffield 2007). The results were analyzed SPSS software.

4 Results

The results will be presented in two sections, starting with the participant data and secondly the survey questions.

4.1 Background information on the respondents

Altogether of the 30 potential participants, 25 (83%) agreed to answer the survey. None of the respondents were filtered out because of careful pre-selection of participants, and in addition to which further confirmed by the survey respondents suitability to participate by question “I have been participating in operating room design”, where all of respondents answered “yes”. The respondents also answered that the building design process phases were either familiar (68%) or party familiar (32%). More than 90 percent of respondent background profile were technical, which was anticipated.

Most of the respondents had work experience of more than 10 years. No respondents represented the work experience group 0 – 5 years. Respondents experience between the operating room design in new building project and the renovation of the old building was mainly focused on the new building. For this reason, the result & analyze part did not take into account the impact of these two different building types on the operating room design process.

The experience of project types was relatively evenly divided between the General Contract, Project Management Contract and Shared Contract, while respondents experience related to Design & Build and Alliance were relatively low.

Table 1. Background information of the respondents

Education	Frequency	Valid Percent	Cumulative Percent
Technical engineers (B. Eng/M. Eng)	23	92,0	92,0
MD or other medical professional	2	8,0	8,0
Total	25	100,0	
Work Experience	Frequency	Valid Percent	Cumulative Percent
0-5 years	0	0,0	0,0
5-10 years	3	10,0	10,0
> 10 years	23	90,0	100
Total	25	100	
Type of building	Frequency	Valid Percent	Cumulative Percent
New building	21	84,0	84,0
Old building renovation	4	16,0	100,0
Total	25	100,0	
Type of project contract model	Frequency	Valid Percent	Cumulative Percent
General Contract	5	20,0	20,0
Project Management Contract	9	36,0	56,0
Alliance	3	12,0	68,0
Build and design	1	4,0	72,0
Shared contract	7	28,0	100,0
Something else	0	0,0	
Total	25	100,0	
Implementation type of Operating Rooms	Frequency	Valid Percent	Cumulative Percent
Traditional model, built in place	12	48,0	48,0
Total delivery of the operating room (1 supplier incl. Walls, doors, incl. Building services etc.)	11	44,0	92,0
Total delivery of the operating room (1 supplier incl. Walls, doors, etc. (Building services traditionally built)	2	8,0	100,0
Total	25	100,0	

Respondents experience in type of implementation were relatively evenly divided between traditional way of building and modular / turnkey (incl. building services) implementation. Only two of respondents had experience of modular / turnkey implementation

with building services traditionally built. For this reason, the option “Total delivery / Building services traditionally built” was be filtered out and ignored in the analyze phase of research question nr. 2.

4.2 Operating room design process (in general)

Table 2 shows the results of the survey regarding the operating room design process at a general level and all respondents. The table shows, starting from the left, the frequency of respondents per question as well as the number of respondents for each selected option, and the percentage value of all respondents. The table highlights in blue for each question the one option that received the most answers, that is, the mode of each question.

Table 2. Results, design process in general

Question	F	%	1	%	2	%	3	%	4	%	5
“Floor height”	25	88,0	22	0,0	0	12,0	3	0,0	0	0,0	0
“Floor area”	25	64,0	16	0,0	0	32,0	8	4,0	1	0,0	0
“Doors”	25	12,0	3	32,0	8	44,0	11	8,0	2	4,0	1
“Wall structures”	25	8,0	2	20,0	5	52,0	13	16,0	4	4,0	1
“Floor surface”	25	0,0	0	8,0	2	44,0	11	40,0	10	8,0	2
”Support struct.”	25	0,0	0	20,0	5	44,0	11	32,0	8	4,0	1
”3D model”	25	0,0	0	32,0	8	28,0	7	40,0	10	0,0	0
”Cleanliness”	25	24,0	6	44,0	11	20,0	5	4,0	1	8,0	2
”Ventilation”	25	12,0	3	48,0	12	28,0	7	0,0	0	12,0	3
”Air distrbution”	25	12,0	3	60,0	15	20,0	5	4,0	1	4,0	1
”Pendants”	25	8,0	2	20,0	5	60,0	15	8,0	2	4,0	1
”Pass trough”	25	0,0	0	20,0	5	48,0	12	24,0	6	8,0	2
”Lighting”	25	16,0	4	0,0	0	64,0	16	8,0	2	12,0	3
”Elect.centers”	25	4,0	1	32,0	8	40,0	10	12,0	3	12,0	3
”Eq. Loads”	25	0,0	0	12,0	3	56,0	14	24,0	6	8,0	2
”Tech. Outlets”	25	0,0	0	4,0	1	48,0	12	40,0	10	8,0	2
”Rad.protect.”	25	12,0	3	20,0	5	56,0	14	8,0	2	4,0	1

Question=Survey question, **1** = Project Planning, **2** =Proposal Design, **3** = General Design**,** **4** = Implementation Design, **5** = I cannot say

In figure 5 can be seen the results of operating room design process, in general. Vertical numbers on the left stands for each survey question.

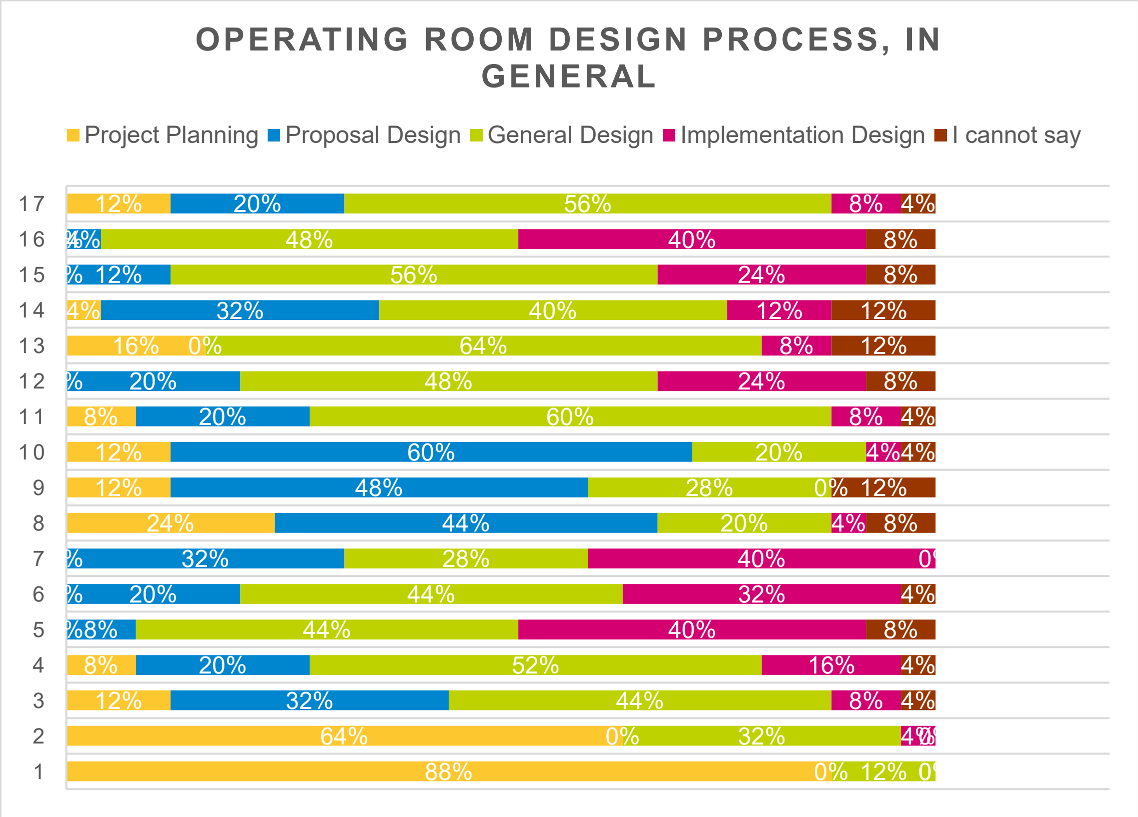

Figure 5. Results, design process in general

The modes are summarized in Table 3, survey results for the design process on general.

Table 3. Results as modes, design process in general

Question	F	%	Design phase
”Floor Height”	22	88,0	Project Planning
”Floor area”	16	64,0	Project Planning
”Doors”	11	44,0	General Design
”Wall structures”	13	52,0	General Design
”Floor material”	11	44,0	General Design
”Support structures”	11	44,0	General Design
”3D model”	10	40,0	Implementation Design
”Cleanliness”	11	44,0	Proposal Design
”Ventilation”	12	48,0	Proposal Design
”Air distribution”	15	60,0	Proposal Design
”Pendants”	15	60,0	General Design
”Passtrough cabinets”	12	48,0	General Design
”Lighting”	16	64,0	General Design
”Electric centers”	10	40,0	General Design
”Equipment loads”	14	56,0	General Design
”Technical outlets”	12	48,0	General Design
”Radiation protection”	14	56,0	General Design

Question =Survey question

4.3 Operating room design process, traditional implementation

Table 4 shows the results of the survey regarding the operating room design process as traditional implementation. The table shows, starting from the left, the frequency of respondents per question as well as the number of respondents for each selected option and the percentage value of all respondents. The table highlights in blue for each question the one option that received the most answers, that is, the mode of each question. When a question got an equal number of answers, it is also shown in the table with the same blue highlight.

Table 4. Results, design process traditional operating room

Question	F	%	1	%	2	%	3	%	4	%	5
“Floor height”	12	91,7	11	0,0	0	8,3	1	0,0	0	0,0	0
“Floor area”	12	83,3	10	0,0	0	16,7	2	0,0	0	0,0	0
“Doors”	12	8,3	1	33,3	4	41,7	5	8,3	1	8,3	1
“Wall structures”	12	16,7	2	8,3	1	41,7	5	16,7	2	16,7	2
“Floor surface”	12	0,0	0	0,0	0	50,0	6	33,3	4	16,7	2
”Support struct.”	12	0,0	0	8,3	1	50,0	6	33,3	4	8,3	1
”3D model”	12	0,0	0	25,0	3	25,0	3	50,0	6	0,0	0
”Cleanliness”	12	41,7	5	33,3	4	8,3	1	8,3	1	8,3	1
”Ventilation”	12	25,0	3	25,0	3	33,3	4	0,0	0	16,7	2
”Air distrbution”	12	8,3	1	58,3	7	25,0	3	0,0	0	8,3	1
”Pendants”	12	16,7	2	16,7	2	50,0	6	8,3	1	8,3	1
”Pass trough”	12	0,0	0	33,3	4	33,3	4	16,7	2	16,7	2
”Lighting”	12	25,0	3	0,0	0	41,7	5	8,3	1	25,0	3
”Elec.centers”	12	8,3	1	25,0	3	25,0	3	16,7	2	25,0	3
”Eq. Loads”	12	0,0	0	8,3	1	50,0	6	25,0	3	16,7	2
”Tech. Outlets”	12	0,0	0	0,0	0	25,0	3	58,3	7	16,7	2
”Rad.protect.”	12	16,7	2	25,0	3	58,3	7	0,0	0	0,0	0

Question=Survey question, **1** = Project Planning, **2** =Proposal Design**, 3** = General Design, **4** = Implementation Design, **5** = I cannot say

In figure 6 can be seen the results of operating room design process, traditional implementation. Vertical numbers on the left stands for each survey question.

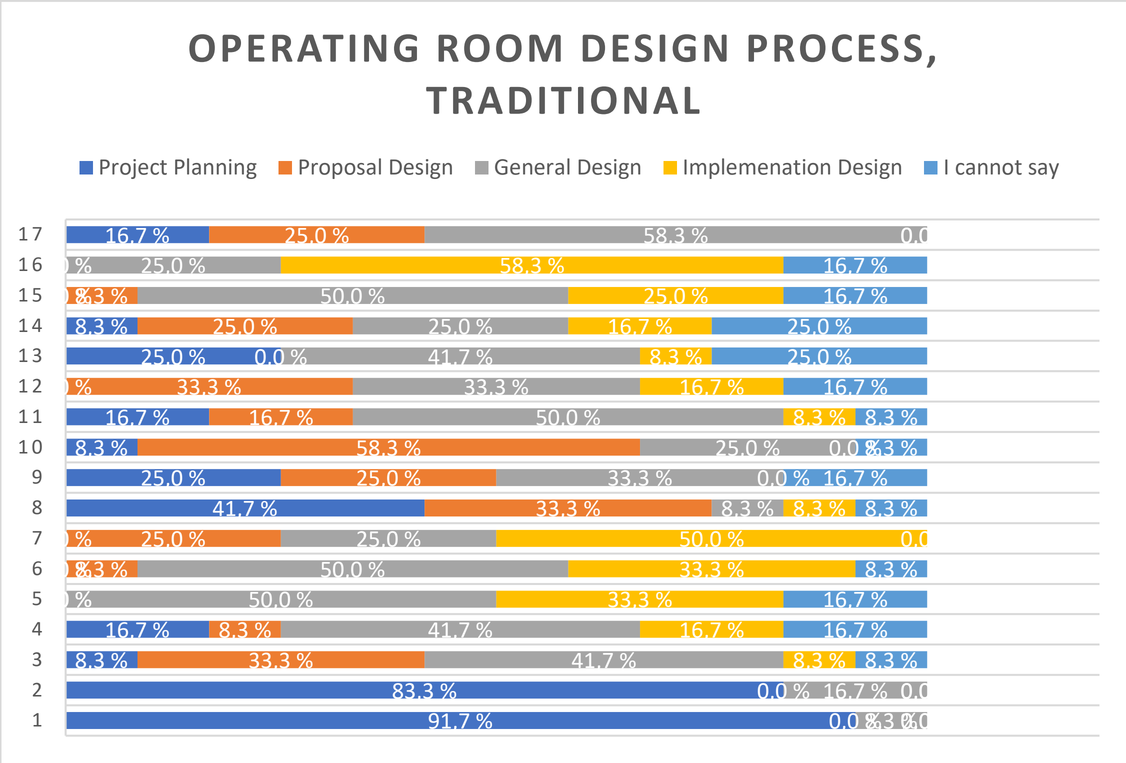

Figure 6. Results, design process traditional operating room

The modes are summarized in Table 5. Survey results for the design process of traditional implementation as following (when a question had an equal number of answers, it is shown in the table).

Table 5. Results as modes, design process traditional

Question	F	%	Design phase
”Floor Height”	11	91,7	Project Planning
”Floor area”	10	83,3	Project Planning
”Doors”	5	41,7	General Design
”Wall structures”	5	41,7	General Design
”Floor material”	6	50,0	General Design
”Support structures”	6	50,0	General Design
”3D model”	6	50,0	Implementation Design
”Cleanliness”	5	41,7	Project Planning
”Ventilation”	4	33,3	General Design
”Air distribution”	7	58,3	Proposal Design
”Pendants”	6	50,0	General Design
”Passtrough cabinets”	4	33,3	Proposal Design / General Design
”Lighting”	5	41,7	General Design
”Electric centers”	3	25,0	Proposal Design / General Design
”Equipment loads”	6	50,0	General Design
”Technical outlets”	7	58,3	Impelentation Design
”Radiation protection”	7	58,3	General design

Question =Survey question

4.4 Operating room design process, modular / turnkey implementation

Table 6 shows the results of the survey regarding the design of operating room design process as modular / turnkey implementation. The table shows, starting from the left, the frequency of respondents per question as well as the number of respondents for each selected option and the percentage value of all respondents. The table highlights in blue for each question the one option that received the most answers, that is, the mode of each question. When a question had an equal number of answers, it is also shown in the table with the same blue highlight.

Table 6. Results, design process modular / turnkey

Question	**F**	**%**	**1**	**%**	**2**	**%**	**3**	**%**	**4**	**%**	**5**
“Floor height”	11	81,8	9	0,0	0	18,2	2	0,0	0	0,0	0
“Floor area”	11	45,5	5	0,0	0	45,5	5	9,1	1	0,0	0
“Doors”	11	18,2	2	27,3	3	45,5	5	9,1	1	0,0	0
“Wall structures”	11	0,0	0	27,3	3	63,6	7	9,1	1	0,0	0
“Floor surface”	11	0,0	0	9,1	1	45,5	5	45,5	5	0,0	0
”Support struct.”	11	0,0	0	27,3	3	45,5	5	27,3	3	0,0	0
”3D model”	11	0,0	0	36,4	4	36,4	4	27,3	3	0,0	0
”Cleanliness”	11	9,1	1	54,5	6	27,3	3	0,0	0	9,1	1
”Ventilation”	11	0,0	0	72,7	8	9,1	1	9,1	1	9,1	1
”Air distrbution”	11	9,1	1	63,6	7	9,1	1	9,1	1	9,1	1
”Pendants”	11	0,0	0	27,3	3	63,6	7	9,1	1	0,0	0
”Pass trough”	11	0,0	0	9,1	1	54,5	6	36,4	4	0,0	0
”Lighting”	11	9,1	1	0,0	0	81,8	9	9,1	1	0,0	0
”Elect.centers”	11	0,0	0	45,5	5	45,5	5	9,1	1	0,0	0
”Eq. Loads”	11	0,0	0	18,2	2	45,5	5	36,4	4	0,0	0
”Tech. Outlets”	11	0,0	0	9,1	1	63,6	7	27,3	3	0,0	0
”Rad.protect.”	11	9,1	1	18,2	2	54,5	6	18,2	2	0,0	0

Question=Survey question, **1** = Project Planning, **2** =Proposal Design, **3** = General Design, **4** = Implementation Design, **5** = I cannot say

In figure 7 can be seen the results of operating room design process, modular / turnkey implementation. Vertical numbers on the left stands for each survey question.

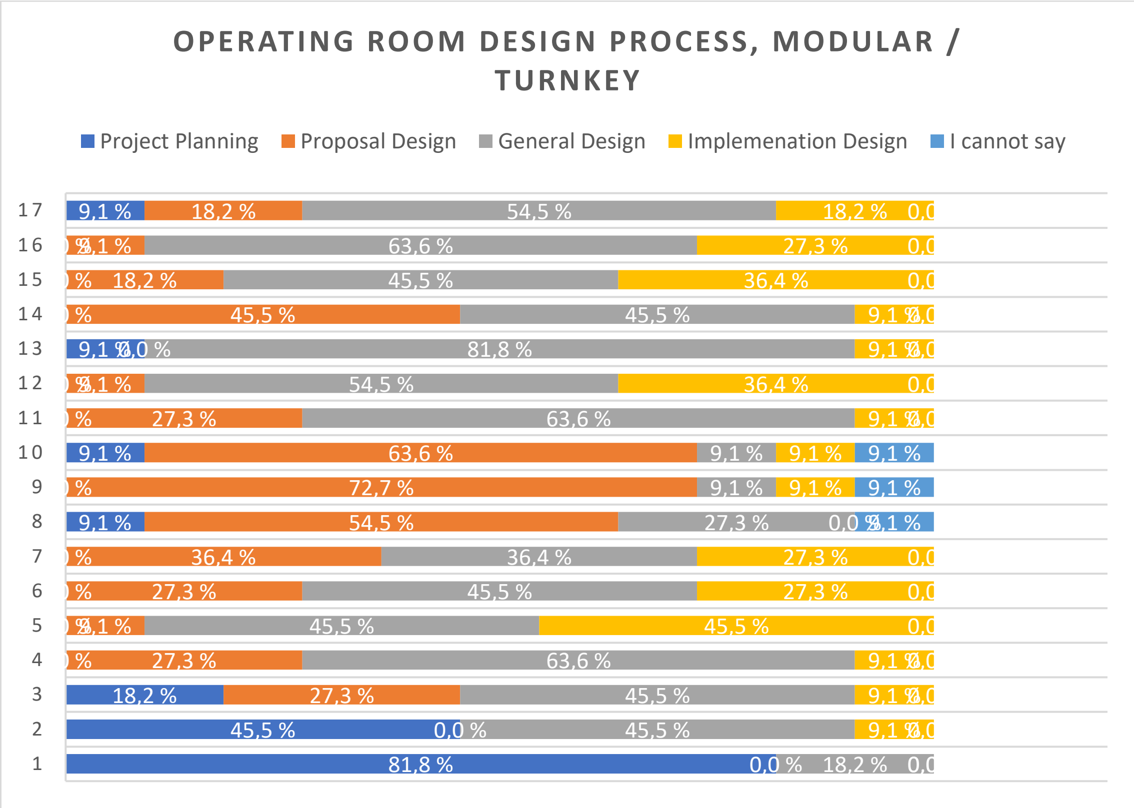

Figure 7. Results, design process turnkey operating room

The modes are summarized in Table 7. Survey results for the design process of traditional implementation as following (when a question had an equal number of answers, it is shown in the table)

Table 7. Results as modes, design process turnkey

Question	**F**	**%**	**Design phase**
”Floor Height”	9	81,8	Proposal Design
”Floor area”	5	45,5	Proposal Design / General Design
”Doors”	5	45,5	General Design
”Wall structures”	7	63,6	General Design
”Floor material”	5	45,5	General Design / Implement. Design
”Support structures”	5	45,5	General Design
”3D model”	4	36,4	Proposal Design / General Design
”Cleanliness”	6	54,5	Proposal Design
”Ventilation”	8	72,7	Proposal Design
”Air distribution”	7	63,6	Proposal Design
”Pendants”	7	63,6	General Design
”Passtrough cabinets”	6	54,5	General Design
”Lighting”	9	81,0	General Design
”Electric centers”	5	45,5	Proposal Design / General Design
”Equipment loads”	5	45,5	General Design
”Technical outlets”	7	63,6	General Design
”Radiation protection”	6	54,5	General Design

Question =Survey question

4.5 Traditional vs. modular/turnkey implementation

The two different way of operating room implementation, Traditional and Turnkey, were analyzed by help of SPSS.

Table 8. Case Processing Summary SPSS, crosstabulation

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Q1 * V1	23	100,0%	0	0,0%	23	100,0%
Q2 * V1	23	100,0%	0	0,0%	23	100,0%
Q3 * V1	22	95,7%	1	4,3%	23	100,0%
Q4 * V1	22	95,7%	1	4,3%	23	100,0%
Q5 * V1	21	91,3%	2	8,7%	23	100,0%
Q6 * V1	22	95,7%	1	4,3%	23	100,0%
Q7 * V1	23	100,0%	0	0,0%	23	100,0%
Q8 * V1	21	91,3%	2	8,7%	23	100,0%
Q9 * V1	20	87,0%	3	13,0%	23	100,0%
Q10 * V1	22	95,7%	1	4,3%	23	100,0%
Q11 * V1	22	95,7%	1	4,3%	23	100,0%
Q12 * V1	21	91,3%	2	8,7%	23	100,0%
Q13 * V1	20	87,0%	3	13,0%	23	100,0%
Q14 * V1	20	87,0%	3	13,0%	23	100,0%
Q15 * V1	21	91,3%	2	8,7%	23	100,0%
Q16 * V1	21	91,3%	2	8,7%	23	100,0%
Q17 * V1	22	95,7%	1	4,3%	23	100,0%

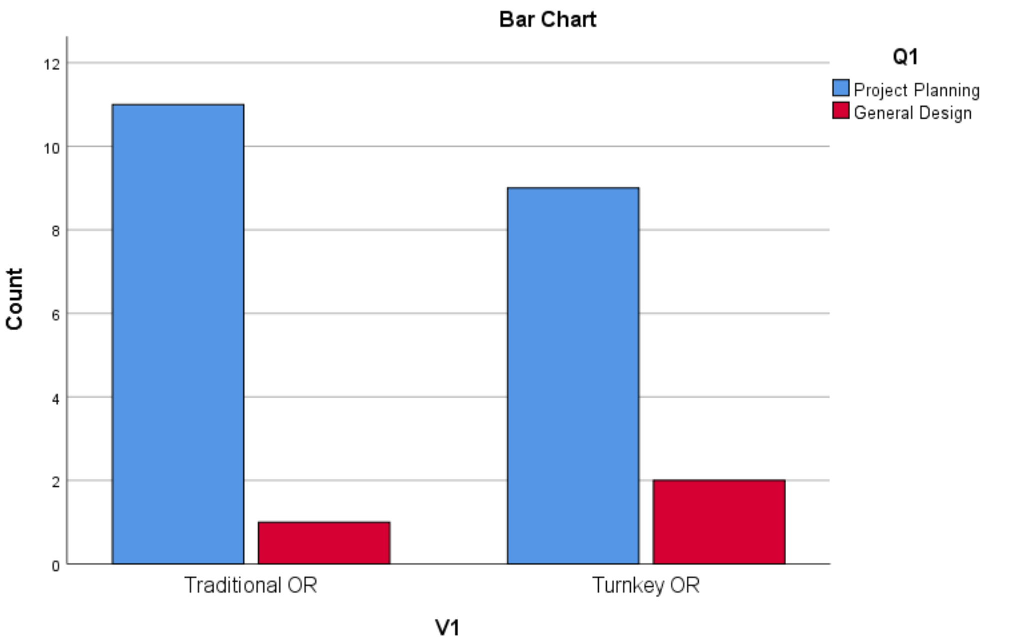

Figure 8. Q1 “The floor height of the operating room should be defined no later than”

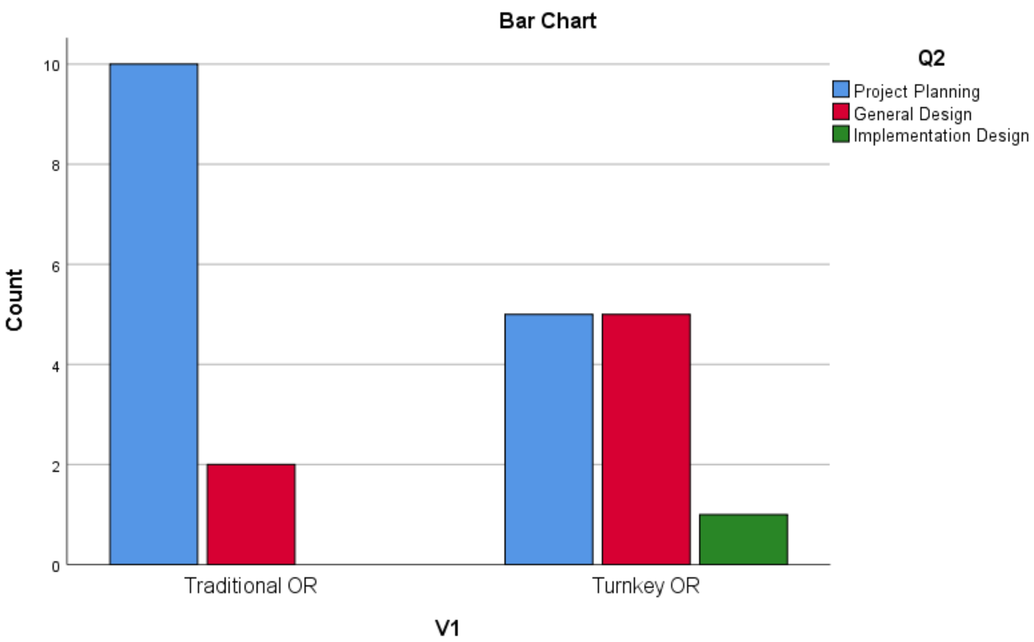

Figure 9. Q2 “The floor area of the operating room should be defined no later than”

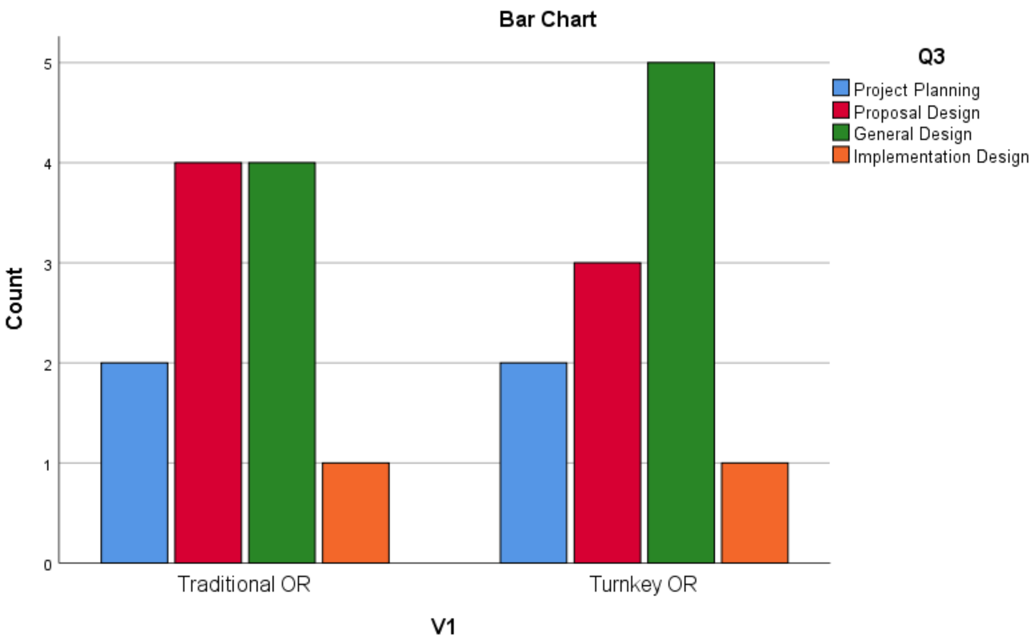

Figure 10. Q3 “The number of operating room doors should be defined no later than”

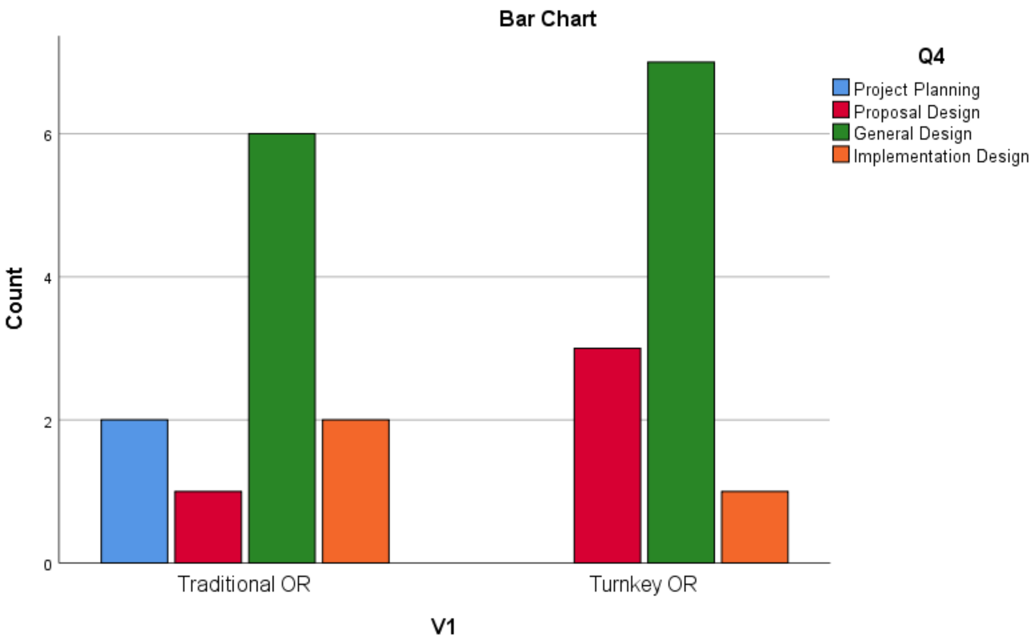

Figure 11. Q4 “The wall structures of the operating room (clean room structure or gypsum board, etc.) should be defined no later than”

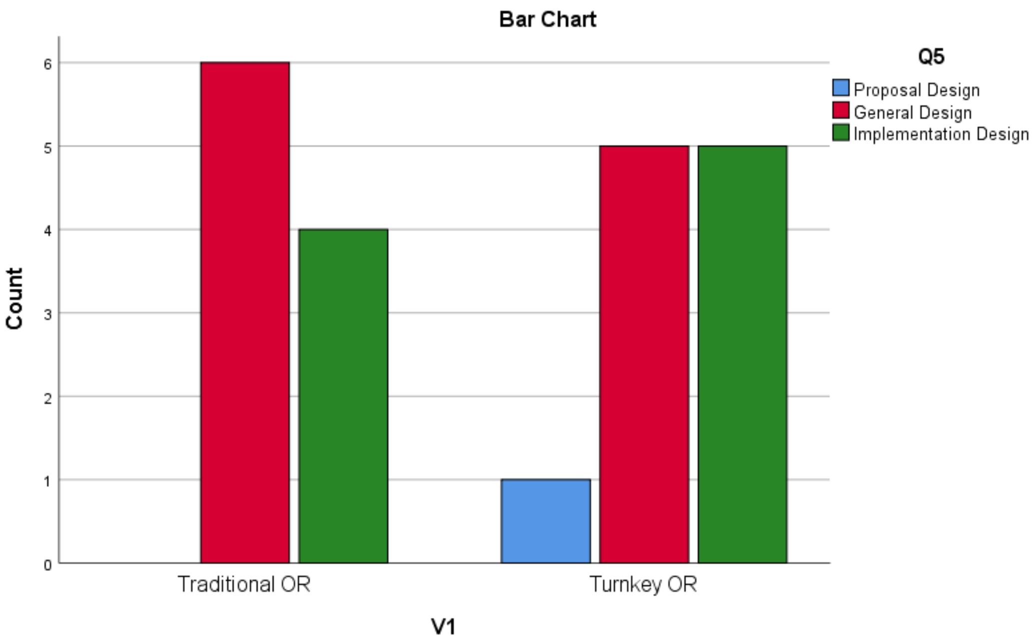

Figure 12. Q5 “The floor surface material of the operating room should be defined no later than”

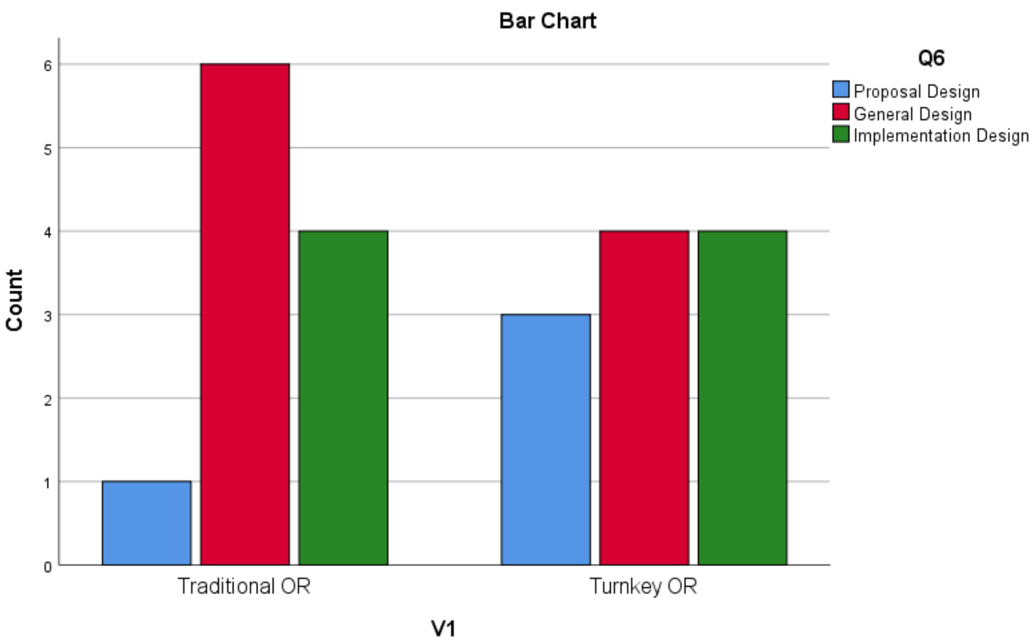

Figure 13. Q6 “Selection of operating room support structures (e.g. Roof perimeter) should be defined no later than”

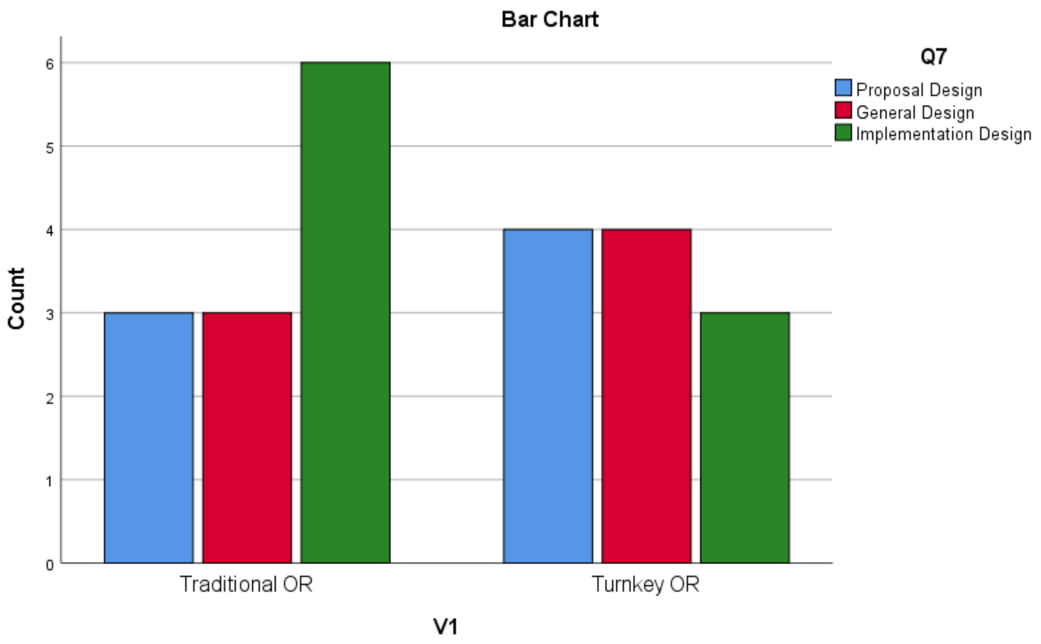

Figure 14. Q7 “3D modeling of the operating room should be started no later than”

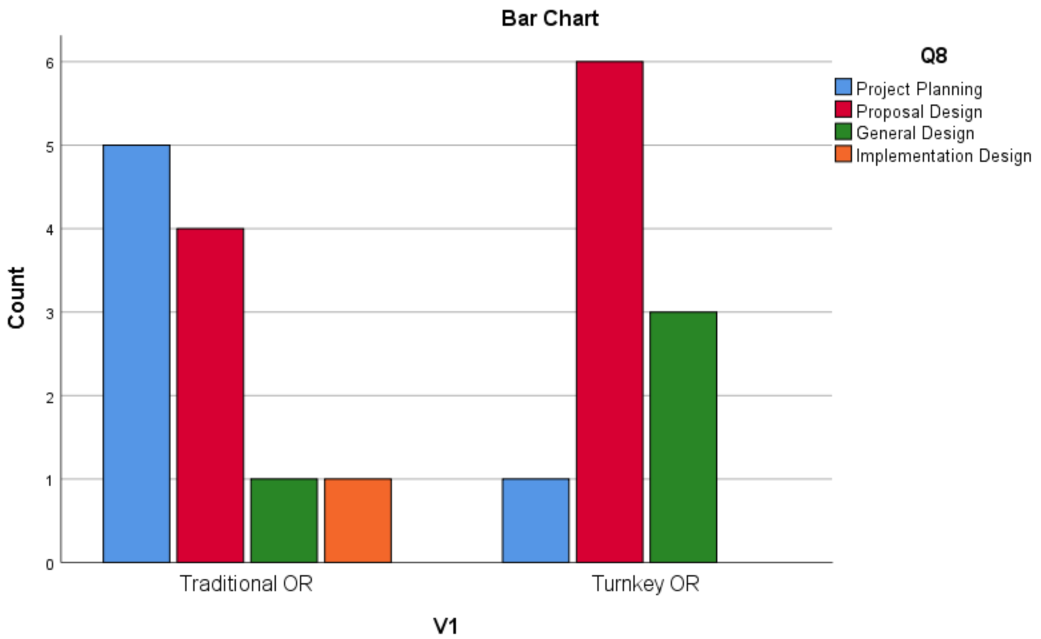

Figure 15. Q8 “The cleanliness level of the operating room (Clean <100 CFU or Ultra Clean <10 CFU) should be defined no later than”

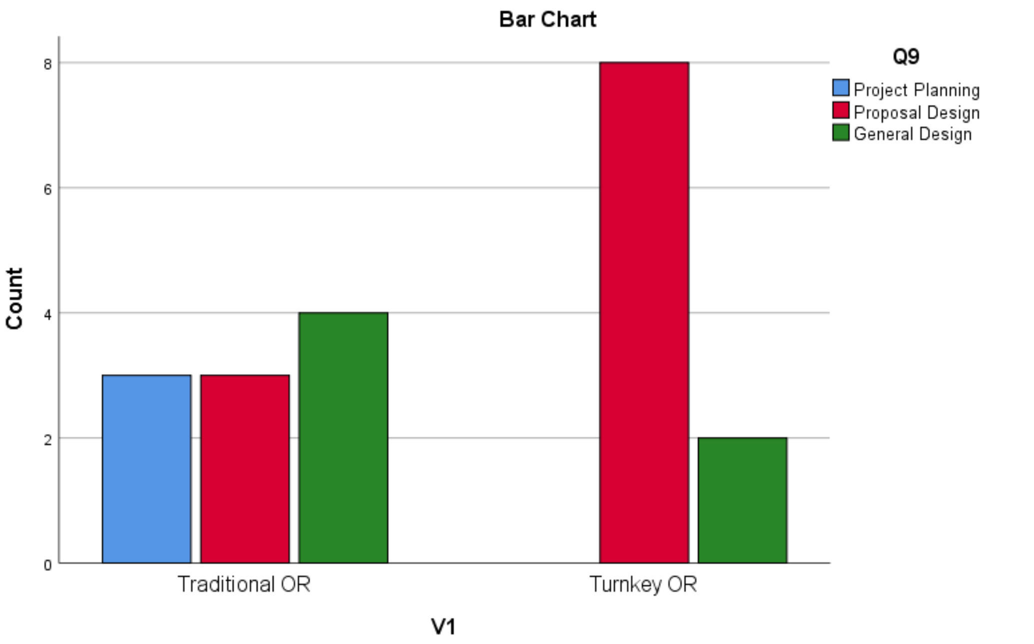

Figure 16. Q9 “The method of ventilation of the operating room (recirculated air + fresh air / fresh air only) should be determined no later than”

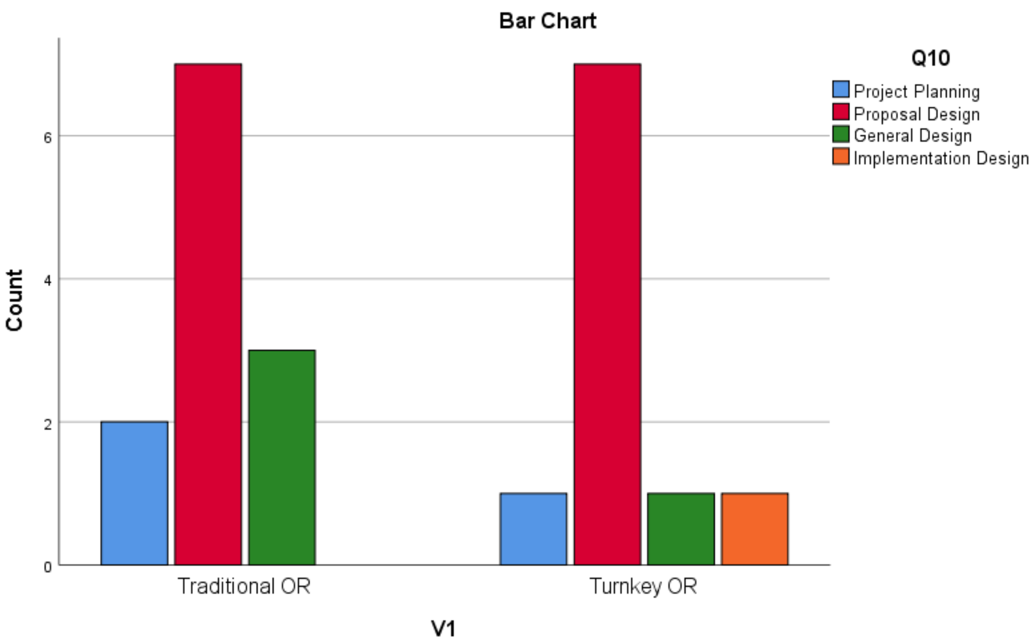

Figure 17. Q10 “The air distribution method of the operating room (mixing / diluting vs. Laminar) should be defined no later than”

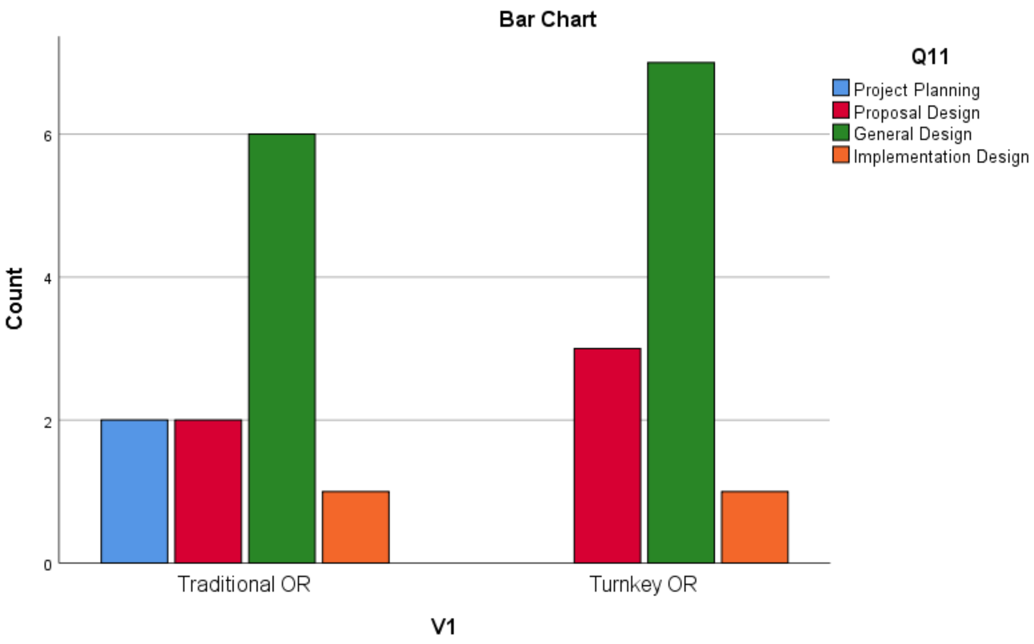

Figure 18. Q11 “The number of operating pendants, arm monitors, etc. should be defined no later than”

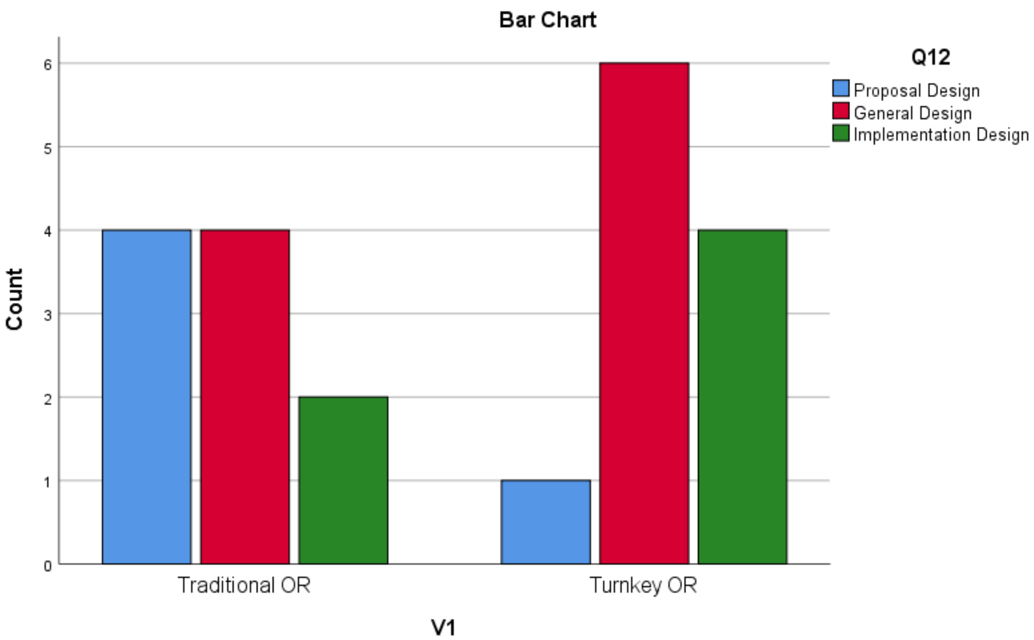

Figure 19. Q12 “The number and types of operating room pass through cabinets (on shelves, trolley etc.) should be defined no later than”

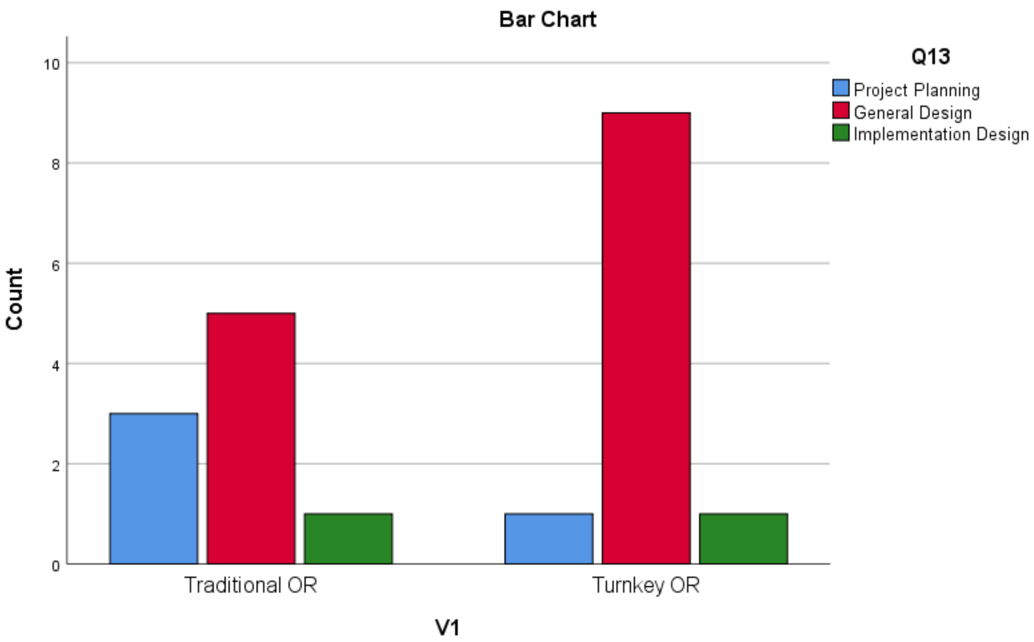

Figure 20. Q13 “Principles for operating room lighting should be defined no later than”

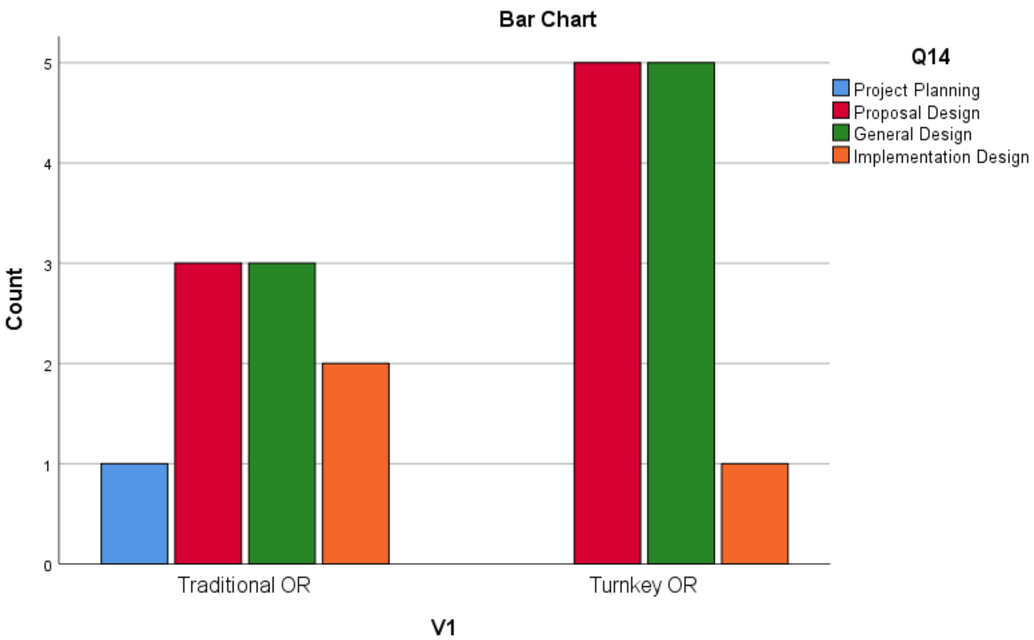

Figure 21. Q14 “The locations of the operating room’s telecom and electrical centers should be defined no later than”

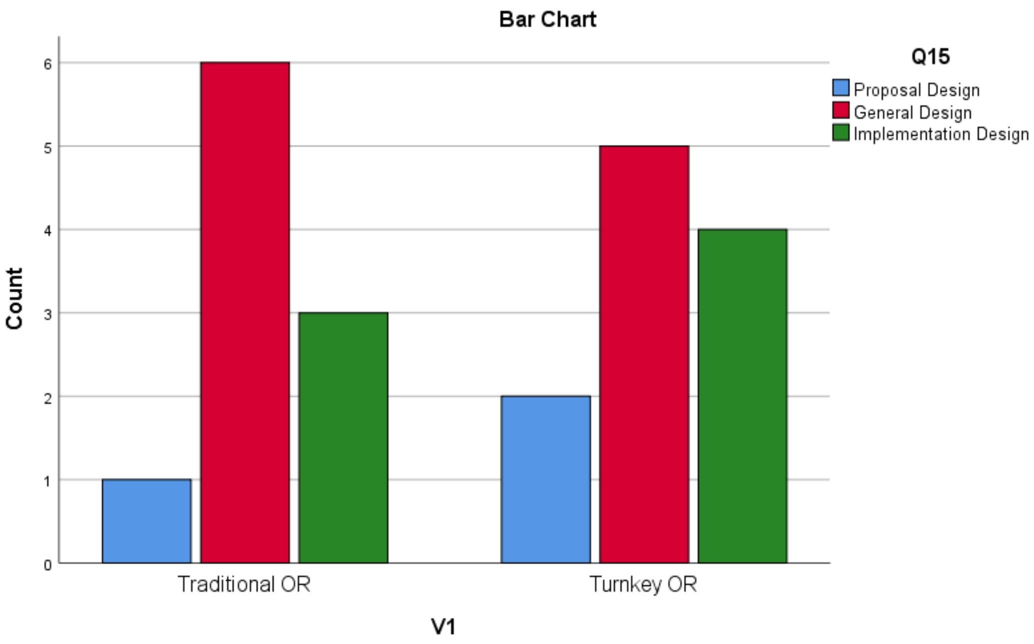

Figure 22. Q15 “The equipment loads of the operating room electrical center should be defined no later than”

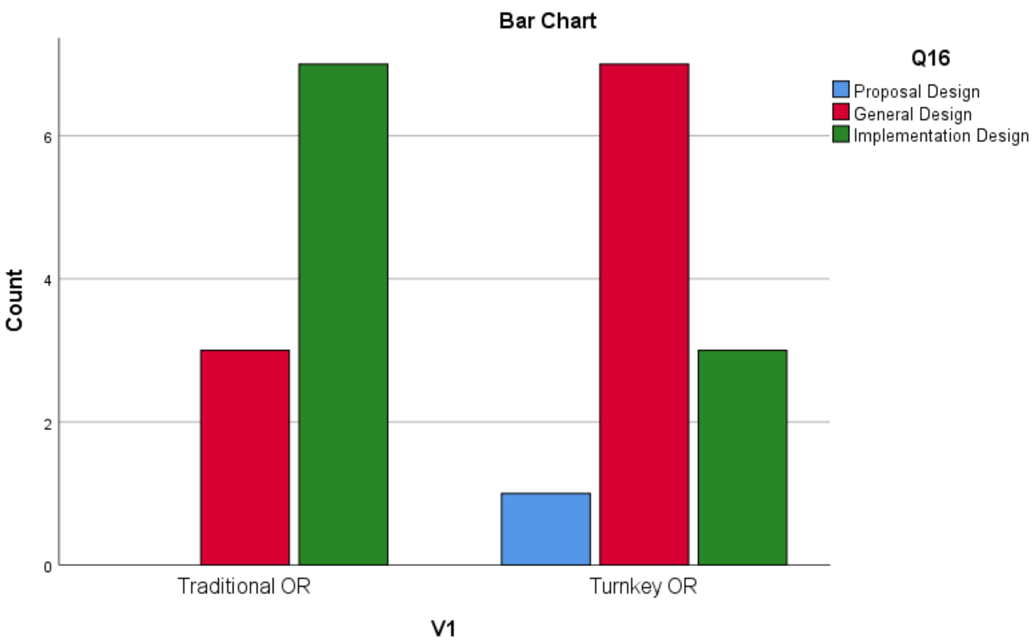

Figure 23. Q16 “The number and location of operating room technology outlets (electricity, tele, data, AV, gas) should be defined no later than”

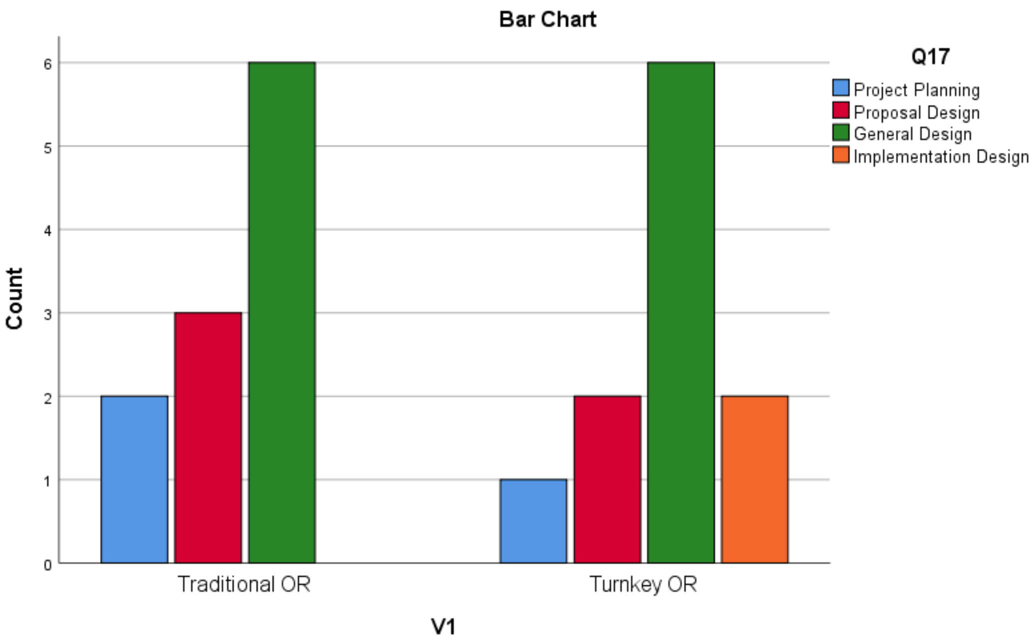

Figure 24. Q17 “Radiation protection in the operating room should be defined no later than”

Based on previous result tables, the modes between traditional implementation and total delivery were compared in Table 9. The table shows, starting from the left, the question number, the frequency of respondents, the percentage of respondents and the design stage. The table also shows when there were an equal number of responses for two different options.

Table 9. Turnkey and traditional implementation comparison with results of modes

	Turnkey OR			**Traditional OR**		
Question	**F**	**%**	**Design phase**	**F**	**%**	**Design phase**
”Floor Height”	9	81,8	Project Planning	11	91,7	Project Planning
“Floor area”	5	45,5	Proj. Plann./Gen.Design	10	83,3	Project Planning
“Doors”	5	45,5	General Design	5	41,7	General Design
“Wall structures”	7	63,6	General Design	5	41,7	General Design
“Floor surface”	5	45,5	Gen. Des./Impl. Des.	6	50,0	General Design
”Support struct.”	5	45,5	General Design	6	50,0	General Design
”3D model”	4	36,4	Prop. Des. or Gen. Des.	6	50,0	Implement. Design
”Cleanliness”	6	54,5	Proposal Design	5	41,7	Project Planning
”Ventilation”	8	72,7	Proposal Design	4	33,3	General Design
”Air distrbut.”	7	63,6	Proposal Design	7	58,3	Proposal Design
”Pendants”	7	63,6	General Design	6	50,0	General Design
”Pass trough”	6	54,5	General Design	4	33,3	Prop. Des./Gen. Des
”Lighting”	9	81,8	General Design	5	41,7	General Design
”Elec.centers”	5	45,5	Prop. Des. /Gen. Design	3	25,0	Prop. Des./Gen. Des.
”Eq. Loads”	5	45,5	General Design	6	50,0	General Design
”Tech. Outlets”	7	63,6	General Design	7	58,3	Implement. Design
”Rad.protect.”	6	54,5	General Design	7	58,3	General Design

Question =Survey question

In table 9, we can see that the design steps are both the traditional and the turnkey solution in many the same. However, there is also some discrepancy between these two different implementations.

Statistical significance (P-value less than 0,05) was observed in only one of the survey questions, number 9 “The method of ventilation of the operating room (recirculated air + fresh air / fresh air only) should be determined no later than” (Table 10).

Table 10. Fisher's Exact test (SPSS)

Question	Value	Exact. Sign.
"Floor Height"		0,590
"Floor area"	3,713	0,115
"Doors"	0,694	1,000
"Wall structures"	3,061	0,467
"Floor material"	1,154	1,000
"Support structures"	1,389	0,650
"3D model"	1,298	0,658
"Cleanliness"	4,712	0,189
"Ventilation"	5,430	**0,041**
"Air distribution"	2,145	0,737
"Pendants"	2,222	0,805
"Passtrough cabinets"	2,660	0,288
"Lighting"	2,094	0,499
"Electric centers"	2,178	0,632
"Equipment loads"	0,671	1,000
"Technical outlets"	3,938	0,124
"Radiation protection"	2,324	0,708

Question =Survey question

4.6 Additional findings

When conducting the study and based on its results, it can be assumed that the type of project and the chosen method of operating the operating room will combined determine the design process, as shown in the figure 25 below. As shown, there are certainly several different specific design processes. The chosen contract model most probably very much defines the operating room design process. However, in this study, the sample was not sufficient to compare these options.

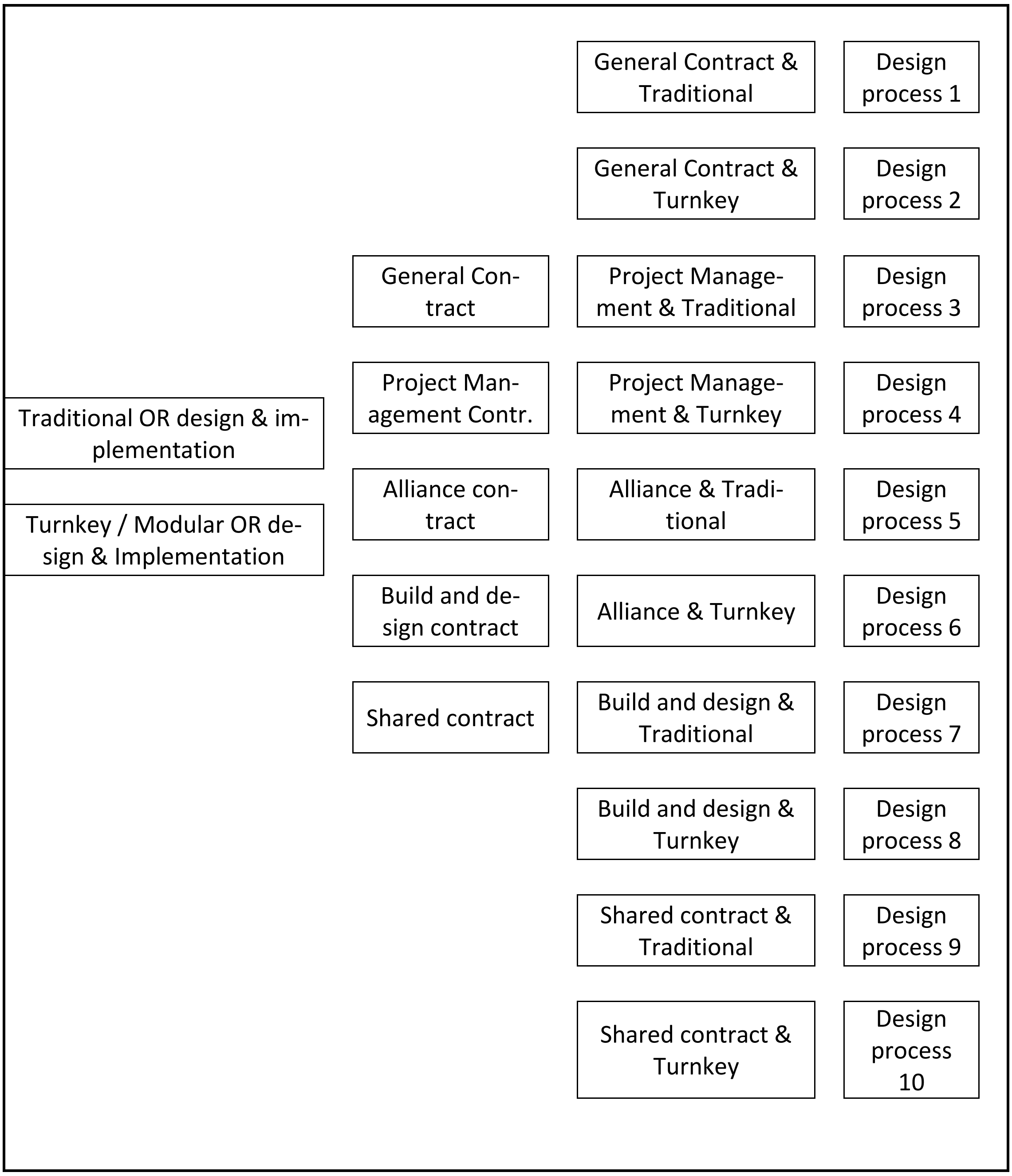

Figure 25. Possible operating room design process variations

Respondents also had the opportunity to leave their own comment on each question in the survey. There were quite few comments, but I picked one I think were most relevant and I also wanted to highlight it in this section of the results. The respondent's comment below was not related to any specific question, it was left in the free comment field at the end of the questionnaire.

”Tämäkin prosessi rakentamis-/korjaustarpeen hyväksymisestä kliiniseen käyttöönottoon pitää saada puristettua murto-osaan nykyisestä. Meillä ”X” -sairaala tulee olemaan "vanhentunut" valmistuessaan, kun koko prosessi on kestänyt vuosia ja suunnitelmat perustuvat monen vuoden takaiseen tilanteeseen ja arvioon. Amsterdamilaiset pystyivät rakentamaan kanavan varren talonsa 9 kuukaudessa, miten ihmeessä me emme nykyään saa uutta rakennusta tai peruskorjausta pystyyn ja toimintavalmiiksi alle 2 vuoden? Minusta meillä pitäisi olla valmis sapluuna miten missäkin vaiheessa edetään.”

“Even this process of approving the need for construction / repair for clinical deployment needs to be squeezed to a fraction of what it is today. For us, “X” Hospital will be “out-dated” when completed, when the whole process has taken years and the designs are based on the situation and assessment many years ago. The people of Amsterdam were able to build their house along the canal in 9 months, how on earth do we not get a new building or renovation up and running in less than 2 years? I think we should have a ready template for how to proceed at any stage.” (free translation)

5 Discussion

The main objective in this study was to find out what is the technical design process of an operating room in general and compare the difference between traditional way vs. turnkey/modular operating room design processes. As it became clear at the beginning of this study, when I got familiar with the limited literature which was available, the process of designing an operating room is a complex, time-consuming and long process, when it usually requires 2-3 years of well-coordinated teamwork. This is probably completely true, at least in the case of a new building that takes a long time to design and then the operating room design process goes hand in hand with the building’s design process and schedules. On the other hand, if the operating room is designed for an already existing building and it is the only project, I think the process can be shorter. However, the key-point in design of the operating room is, that it certainly requires a well-organized collaboration and spirit between the different stakeholders to get the best possible outcome. I can imagine that each party and specialty in the design process has its own desires, goals, and constraints. This study was addressed only on technical design,

but when we include the architects and functional designers, most probably the complexity increases exponentially. The functional designers and architects search for advance solutions for the best possible operational function of the hospital and operating unit, and it can be imagined that differing opinions and solutions might occur with the technical part and certain limitations.

5.1 Design process on general level

In the beginning of this research, I was in belief that the design process for operating rooms would generally be very clear and straightforward. I assumed that when operating rooms are being designed and built in Finland a lot nowadays, the process would even be almost "standardized". However, based on the results of this research, there seems to be almost as many design processes for the operating room as there are type of projects, designers, end users, and builders. The current results showed that there may not be a clear process. Although certain questions in the survey provided the most answers for a particular design stage, but for many questions the situation was that the second option was very close to the same level. Respondents did not seem to have a clear consensus on the design and principle decisions of the process. Here, perhaps, it can be said that the clear boundary is in fact very volatile between certain design stages, e.g. proposal design and general design phase. According to the results, it can only be estimated whether the design and principle decisions of something is made at the beginning or towards the end of the project. As a rough summary, most of the design and principle decisions seems to be made in early stages of the project, either project planning, proposal design or general design phase. This means that implementation design phase is mostly design work according to decisions that has been made in advance.

This raises the question of whether and how flexibly decisions already made can be changed in later phase, implementation design, when the design process is long and there most probably will be this kind of need (referring respondent free comment in chapter 4.6). As also stated in chapter 2.1, the changes in the final phase are usually very costly and difficult to manage and implement This certainly emphasizes the smoothness of the collaboration and the accuracy of the decisions made in the early stages of design.

A few operating room design and principle decision stages were clearer when then others. However, this generic review process is not reliable because it turned out that the project contract model and the type operating room implementation determine the design process. Thus, the findings to research question number 1 one is not a valid other than at a rough level.

5.2 Design process modular/turnkey vs. traditional

When starting this research, my first assumption was also that there would have been more significant differences between the traditional and modular/turnkey implementation design process. The procurement process in general of a modular/turnkey operating room is very different from the traditional one. However, the comparison of the traditional and modular / turnkey operating room design process revealed that it was very similar in most areas. When testing the statistical significance, it can be stated that only for “The method of ventilation of the operating room (recirculated air + fresh air / fresh air only) should be determined no later than” the difference was statistically significant (Exact sign. = 0.041).

5.3 Additional findings

As I presented in Section 4.6, one important factor that certainly defines the design process is the contract model chosen for the project and the way the operating room is implemented. The different combinations of these certainly create different types of design processes. Whether the design responsibility is on the customer, project management contractor, construction contractor etc., affects at what stage which design is done and who is responsible for the implementation. The type and impact of the contract model on the design process could not be considered in this study due to the small sample size, as the result would not have been at a reliable level. If the operating room design process is to be developed in the future, to make it more clear or standardized, the impact of different contract models should be included in the review.

When for example, a general contract or a shared contract is selected for the project, then the client or builder is responsible for the design and the design process according to which the main or other contractors are selected for the project, so the designs must be fully ready already at the tendering stage. While a design and build contract or project management contract is chosen as the project contract model, then the main contractor is responsible for the design and the design process. In these options alone there are very different implementations and the design is on responsibility of a different parties. Also, the alliance project model is again completely different from the previous ones mentioned and the design process may be different there.

As this study progressed, it became clear that the impact of contract models should also be included in the analysis. This was to be done, but the sample sizes between the contract models was too small so that this could not be done at a reliable level.

This research was just a scratch on the surface regarding operating room design, and I believe there are sure to be points for future development and efficiency in the design and building of operating rooms, which can achieve time and economic benefits. The design of the operating room is a large and challenging project, but would there be a possibility to simplify or make the process clear and shorten the design timeline from current?

I'm not an operating room specialist myself, but I think that all operating rooms are in the end quite similar when completed, box (operating room) in a box (building) and almost similar size in all the hospitals. Does every operating room project really require 2-3 years of design? Could the operating room be somehow basic / standardized with certain boundary conditions that can then be customized on a project-by-project basis? For example, a total delivery that would have been thought through to the end, considering the changes in the final phase of the project, under certain boundary conditions of course. The concept would have a pre-thought-out and honed conversion flexibility to the end. Perhaps in such a concept, certain decisions and solutions could be made more at the end of the project? As I presented in section 2.4, the biggest challenges in hospital design are design traditions and lack of know-how. At the same time, the people involved in the project may be involved in it for the first time, and possibly it will also last time at the same. Because of this, it would be good if knowledge and experiences could be somehow be shared open and widely.

5.4 Validity and reliability of the research

The overall reliability of the study is good, when the sample represents the population and there are as few random errors as possible in the measurement. The overall reliability can be assessed, for example, by re-measurement. Reliability is improved when the research question is clearly and precisely defined, the research population is reasonably selected and the sample from the population is carefully defined. The things to be measured must be defined unambiguously and precisely, and the questions as concrete as possible. It must also be ensured that the questions and possible answers are correctly defined for the matter under investigation. The validity of a study is on good level when the researcher has not been misled at the level of concepts and no systematic errors occurs (Vilkka 2007: 151-153).

The questionnaire was be tested in advance and the timing of survey was also chosen to suit the research target group. Data entry was done carefully and checked before saving, and the research process was done in honest and transparent way (Vilkka 2007: 151-153).

The questions in the survey were defined together with my colleagues who have been working with operating room projects and deliveries for several years. The survey questionnaire was first piloted internally as well as with a partner who is professional and working daily with design of operating rooms. The survey was modified based on their responses and comments before being sent to the target group.

The participants for the research were carefully selected and all of them were operating room professionals of different fields. The number of participants in the study was relatively small, but all participants were long-line professionals when almost all had more than 10 years of work experience. The number of participants remained small, because the design of operating theaters is a very narrow special sector whose design professionals simply could not be found much more in a country the size of Finland. However, response rate of the survey was high as 83%. I think the quality of the participants replaced the relatively small sample.

The results of this research can be used in broader further studies related to the development of the operating room design process.

5.5 Ethics

This thesis was conducted in line with the ethics of the European Code of Conduct for research integrity, which states that reliability is acquired through quality of research in terms of methodology, analysis, design and of resources; honesty is achieved through transparency, neutrality and fairness; respect is to be paid towards all parties and accountability throughout the research. Methods used were valid and data was presented in an honest and transparent way (ALLEA 2007).

No personal data was collected and the participants were informed that about the research and convinced that the information cannot be targeted to them in any way (ALLEA 2007). The research participants were contacted in advance by email or phone call asking for permission to participate in this study. At that point, I explained the topic and purpose of the study. I provided each participant with a study information sheet outlining the subject, objective, and client of the study. There was also mentioned separately the time required for participating (this was tested in advance) and that the participation in the study is voluntary and no contact information will be collected

6 Conclusion

The results of this study are based on the experience of operating room design professionals in operating room design projects, so it is safe to say at this point that there is no clear design process, at least at a general level. There are significantly more details, coordinations and interfaces in different technologies and disciplines in the design of special spaces. I believe there are existing processes for this in individual hospitals and design offices, but there does not seem to be a generic process for this.

The design time of the operating room is generally long, which may cause needs for modifications as soon as it is completed, because the information used in the design can already a bit outdated at that stage. Technology solutions and need may have changed over the years.

As further development, I propose a broader study of the operating room design process that would be done in the context of a real case study. This would take into account the

whole (including functional design) and that would be broken down into small pieces and look at their impact on each other as well as the timeline of the design. As result there could be a “guide” for operating room design that could be used for managing operating room design and implementation. This “guide” should also be maintained on an ongoing basis with the knowledge and experience gained from real projects. With such a tool, not everyone always has to start from scratch when designing an operating room. This would also make it known which decisions and choices should and could be made at what stage and which other areas will be affected by these decisions. I would encourage transparency and the sharing of experiences to further improve the quality of the design and implementation of operating rooms.

It would also be interesting to compare the technical vs. functional designer / architects and their differences in view of the operating room design process. In this case, the sample should be increased by including these professional groups in the research.

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Internet Survey

Osallistujan tietolomake

OSALLISTUJAN TIETOLOMAKE

Tutkimuksen otsikko: Operating room design process (From the view of building design)

Kutsu osallistua tutkimukseen

Tervetuloa vastaamaan leikkaussalisuunnittelu -kyselyyn.

Kysely on lähetetty henkilöille suunnittelutoimistoihin ja sairaaloihin jotka ovat nykyään tai olleet lähiaikoina mukana sairaala- ja leikkaussalisuunnittelussa.

Osallistuminen

Osallistuminen tähän tutkimukseen on vapaaehtoista. Voit vetäytyä tutkimuksesta milloin tahansa ilmoittamatta mitään syytä ja ilman mitään kielteisiä seurauksia.

Vastaat tähän kyselyyn nimettömänä emmekä kerää tai tallenna henkilö-, yhteys-, selantietoja tai IP-osoitteita.

Tutkimuksen tarkoitus

Tämän tutkimuksen tarkoituksena on kehittää leikkaussalien kokonaistoimituskonseptia vastaamaan nykyistä paremmin leikkaussalien suunnitteluprosessia.

Tutkimuksen aiheena on selvittää että mikä on yksittäisen standard -leikkaussalin tekninen suunnitteluprosessi (pääpiirteittäin) rakennuksen suunnitteluprosessin näkökulmasta. Tutkimuksen toisena tavoitteena on tarkastella että miten suunnitteluprosessit eroaa toisistaan kun vertaillaan leikkaussalin perinteistä toteutustapaa ja leikkaussalin kokonaistoimitusta.

Tutkimuksen toteuttaja ja tilaaja

Tutkimuksesta vastaa Wille Nurmi ja kyseessä on Metropolia YAMK-päättötyö (M.Eng. / Health Business Management). Tutkimuksen tilaaja on Halton Oy.

Osallistuminen tutkimukseen

Tutkimukseen osallistutaan vastaamalla web -kyselyyn joka kestää n. 10 minuuttia.

Lomake on ajastettu: julkisuus alkaa 5.11.2020 14.15 ja päättyy 12.11.2020 23.59

Tervetuloa vastaamaan kyselyyn! -Leikkaussalisuunnittelu

Vastaat tähän kyselyyn nimettömänä emmekä kerää tai tallenna henkilö-, yhteys-, selantietoja tai IP-osoitteita.
Kyselyyn vastaaminen kestää n. 10 minuuttia (Huom! vastauslinkki on avoin 12.11 asti)

Tutkimme tässä kyselyssä leikkaussalien suunnitteluprosessia rakennushankkeen suunnitteluprosessin näkökulmasta (HJR12 & TATE12)

Mikäli sinulla on kokemusta useammasta hankkeesta ja urakkamallista, valitse näistä esim. viimeisin tai mielestäsi parhaiten onnistunut ja pidä kyseinen projekti mielessä koko kyselyn ajan. Voit myös halutessasi vastata kyselyyn useampaan kertaan.

Ohjeet ja terminologiaa

- Aloita kysely täyttämällä esitiedot, jonka jälkeen voit vastata kysymyksiin valitsemalla aina yhden vastausvaihtoehdoista. Voit myös jättää vapaan kommentin jokaisen kysymyksen kohdalle, tai erikseen kyselyn lopussa siihen varattuun tilaan (enemmän tilaa tekstille).

- Kysely koskee ns. standard leikkaussalia (sali joka on tarkoitettu yleiskirurgiaan, jota ei ole spesifioitu erityisen toimialan käyttöön)

Leikkaussali, perinteisesti rakennettu
tarkoitetaan leikkaussalihankintaa/-rakentamista joka toteutetaan perinteisellä rakentamistavalla. Kaikista leikkausalin rakentamiseen liittyvistä osa-alueista vastaa pääurakoitsijan/tilaajan valitsemat oman alan urakoitsijat, kuten seinätoimittaja, talotekniikkaurakoitsijat jne. Leikkaussalin toimitusvastuu on tällöin jaettu eri urakoitsijoille.

Leikkaussali, kokonaistoimitus
tarkoitetaan leikkaussalihankintaa/-rakentamista joka toteutetaan vastuuttamalla yksi toimittaja vastaamaan leikkaussalin rakentamisesta. Kaikista leikkausalin rakentamiseen liittyvistä osa-alueista (seinät, ovet, talotekniikka jne.) vastaa pääurakoitsijan/tilaajan valitsema yksi toimittaja (leikkaussalin kokonaistoimituksesta käytetään Suomessa laajasti myös nimitystä moduulileikkaussalitoimitus). Leikkaussalin toimitusvastuu on yhdellä toimittajalla.

Voit halutessasi tutustua:
RAKENNUSHANKKEEN TEHTÄVÄLUETTELO
URAKKAMUODOT (TIIVISTELMÄ)
OSALLISTUJAN TIETOLOMAKE
(Vinkki: paina ensin Ctrl, niin dokumentit avautuu uuteen ikkunaan)

Vastaajan perustiedot

Tehtävänimike *

Koulutusala/Tutkinto *

Työkokemus (vuosia) * --Valitse tästä--

Olen ollut mukana leikkaussalien suunnittelussa * --Valitse tästä--

Oliko kyseessä uudisrakennus vai vanhan rakennuksen saneeraus?

Valitse yksi vaihtoehdoista
- Uudisrakennus
- Vanhan rakennuksen saneeraus

Mikä oli rakennushankkeen urakkamuoto?

* Valitse yksi vaihtoehdoista
- Kokonaisurakka
- Projektinjohtourakka
- Allianssi
- SR/KVR urakka
- Jaettu urakka
- Joku muu
- En osaa sanoa

Vapaa kommenttikenttä

Mikä oli leikkaussalien hankinta/-toteutusmuoto?

Valitse yksi vaihtoehdoista
- Perinteinen malli, paikallaan rakennettu
- Leikkaussalin kokonaistoimitus (1 toimittaja sis. seinät, ovet, min. salin sisäpuolinen talotekniikka ym.)
- Leikkaussalin kokonaistoimitus (1 toimittaja sis. seinät, ovet ym. (salin talotekniikka perinteisesti rakentaen)

Rakennushankkeen vaiheet HJR12 ja TATE12 mukaisesti on: Tarveselvitys, Hankesuunnittelu, Suunnittelunvalmistelu, Ehdotussuunnittelu, Yleissuunnittelu, Rakennuslupatehtävät, Toteutussuunnittelu, Rakentamisen valmistelu, Rakentaminen, Käyttöönotto, Takuu

Valitse yksi vaihtoehdoista
- Käsitteet ja vaiheet ovat minulle tuttuja
- Käsitteet ja vaiheet ovat minulle osittain tuttuja
- Käsitteet ja vaiheet eivät ole minulle tuttuja

Huom! Tässä kyselyssä käsitellään ainoastaan suunnitteluvaiheita / Vapaa kommentti

Kysymykset

Leikkaussalin kerroskorkeus tulisi määrittää viimestään

* Valitse yksi vaihtoehdoista
- ○ Hankesuunnitteluvaiheessa
- ○ Ehdotussuunnitteluvaiheessa
- ○ Yleissuunnitteluvaiheessa
- ○ Toteutussuunnitteluvaiheessa
- ○ En osaa sanoa

Vapaa kommentti

Leikkaussalin pinta-ala tulisi määrittää viimestään

* Valitse yksi vaihtoehdoista
- ○ Hankesuunnitteluvaiheessa
- ○ Ehdotussuunnitteluvaiheessa
- ○ Yleissuunnitteluvaiheessa
- ○ Toteutussuunnitteluvaiheessa
- ○ En osaa sanoa

Vapaa kommentti

Leikkaussalin ovien lukumäärä tulisi määrittää viimeistään

* Valitse yksi vaihtoehdoista
- ○ Hankesuunnitteluvaiheessa
- ○ Ehdotussuunnitteluvaiheessa
- ○ Yleissuunnitteluvaiheessa
- ○ Toteutussuunnitteluvaiheessa
- ○ En osaa sanoa

Vapaa kommentti

Leikkaussalin seinärakenteet (puhdastilarakenne tai kipsilevy tms.) tulisi määrittää viimeistään

* Valitse yksi vaihtoehdoista
- ○ Hankesuunnitteluvaiheessa
- ○ Ehdotussuunnitteluvaiheessa
- ○ Yleissuunnitteluvaiheessa
- ○ Toteutussuunnitteluvaiheessa
- ○ En osaa sanoa

Vapaa kommentti

Leikkaussalin lattiapintamateriaali tulisi määrittää viimeistään

* Valitse yksi vaihtoehdoista
- Hankesuunnitteluvaiheessa
- Ehdotussuunnitteluvaiheessa
- Yleissuunnitteluvaiheessa
- Toteutussuunnitteluvaiheessa
- En osaa sanoa

Vapaa kommentti

Leikkassalin erilliset KSL -kannatusrakenteiden (ts. kattokehä) valinta vrt. EI erillisiä kannatusrakenteita) tulisi määrittää viimestään

* Valitse yksi vaihtoehdoista
- Hankesuunnitteluvaiheessa
- Ehdotussuunnitteluvaiheessa
- Yleissuunnitteluvaiheessa
- Toteutussuunnitteluvaiheessa
- En osaa sanoa

Vapaa kommentti

Leikkaussalin 3D-mallintaminen tulisi aloittaa viimeistään

* Valitse yksi vaihtoehdoista
- Hankesuunnitteluvaiheessa
- Ehdotussuunnitteluvaiheessa
- Yleissuunnitteluvaiheessa
- Toteutussuunnitteluvaiheessa
- En osaa sanoa

Vapaa kommentti

Leikkaussalin puhtaustaso (Clean <100 CFU tai Ultra Clean <10 CFU) tulisi määrittää viimeistään

* Valitse yksi vaihtoehdoista
- Hankesuunnitteluvaiheessa
- Ehdotussuunnitteluvaiheessa
- Yleissuunnitteluvaiheessa
- Toteutussuunnitteluvaiheessa
- En osaa sanoa

Vapaa kommentti

Leikkaussalin ilmanvaihtotapa (kiertoilma+ raitisilma / pelkkä raitisilma) tulisi määrittää viimeistään

* Valitse yksi vaihtoehdoista
- Hankesuunnitteluvaiheessa
- Ehdotussuunnitteluvaiheessa
- Yleissuunnitteluvaiheessa
- Toteutussuunnitteluvaiheessa
- En osaa sanoa

Vapaa kommentti

Leikkaussalin ilmanjakotapa (sekoittava/laimentava vs. Laminaari) tulisi määrittää viimeistään

* Valitse yksi vaihtoehdoista
- ◯ Hankesuunnitteluvaiheessa
- ◯ Ehdotussuunnitteluvaiheessa
- ◯ Yleissuunnitteluvaiheessa
- ◯ Toteutussuunnitteluvaiheessa
- ◯ En osaa sanoa

Vapaa kommentti

Leikkaussalin kattokeskuksien, varsimonitorien ym. lukumäärä tulisi määrittää viimeistään

* Valitse yksi vaihtoehdoista
- ◯ Hankesuunnitteluvaiheessa
- ◯ Ehdotussuunnitteluvaiheessa
- ◯ Yleissuunnitteluvaiheessa
- ◯ Toteutussuunnitteluvaiheessa
- ◯ En osaa sanoa

Vapaa kommentti

Leikkaussalin läpiantokaappien määrä ja tyypit (hyllyillä, vaunut tms.)tulisi määrittää viimeistään

* Valitse yksi vaihtoehdoista
- ◯ Hankesuunnitteluvaiheessa
- ◯ Ehdotussuunnitteluvaiheessa
- ◯ Yleissuunnitteluvaiheessa
- ◯ Toteutussuunnitteluvaiheessa
- ◯ En osaa sanoa

Vapaa kommentti

Leikkaussalin valaistuksen periaateratkaisut tulisi määrittää viimeistään

* Valitse yksi vaihtoehdoista
- ◯ Hankesuunnitteluvaiheessa
- ◯ Ehdotussuunnitteluvaiheessa
- ◯ Yleissuunnitteluvaiheessa
- ◯ Toteutussuunnitteluvaiheessa
- ◯ En osaa sanoa

Vapaa kommentti

Leikkaussalin tele- ja sähkökeskuksien sijainnit tulisi määrittää viimeistään

* Valitse yksi vaihtoehdoista
- ◯ Hankesuunnitteluvaiheessa
- ◯ Ehdotussuunnitteluvaiheessa
- ◯ Yleissuunnitteluvaiheessa
- ◯ Toteutussuunnitteluvaiheessa
- ◯ En osaa sanoa

Vapaa kommentti

Leikkaussalin sähkökeskuksen laitekuormat tulisi määrittää viimeistään

* Valitse yksi vaihtoehdoista

- ◯ Hankesuunnitteluvaiheessa
- ◯ Ehdotussuunnitteluvaiheessa
- ◯ Yleissuunnitteluvaiheessa
- ◯ Toteutussuunnitteluvaiheessa
- ◯ En osaa sanoa

Vapaa kommentti

Leikkaussalin tekniikan ulosottopisteiden (sähkö, tele, data, AV, kaasu) määrät ja sijainnit tulisi määrittää viimeistään

* Valitse yksi vaihtoehdoista

- ◯ Hankesuunnitteluvaiheessa
- ◯ Ehdotussuunnitteluvaiheessa
- ◯ Yleissuunnitteluvaiheessa
- ◯ Toteutussuunnitteluvaiheessa
- ◯ En osaa sanoa

Vapaa kommentti

Leikkaussalin säteilysuojaukset tulisi määrittää viimeistään

* Valitse yksi vaihtoehdoista

- ◯ Hankesuunnitteluvaiheessa
- ◯ Ehdotussuunnitteluvaiheessa
- ◯ Yleissuunnitteluvaiheessa
- ◯ Toteutussuunnitteluvaiheessa
- ◯ En osaa sanoa

Vapaa kommentti

Kiitos kyselyyn osallistumisesta! Mikäli haluat jättää vapaat kommentit liittyen kyselyyn tai leikkaussalien suunnitteluprosessiin, sana on vapaa, Kiitos ja hyvää syksyä!

Tietojen lähetys

Tallenna | Esitäyttö URL

Partcipant info	**Answers (select one of the options)**	
Job Title	xxxxx	
Education	xxxxx	
Work experience in years	0-5 years	
	5 - 10 years	
	> 10 years	
I have participated in Operating room design	Yes	
	No	
Was it a new building or a renovation of an old building?	New Building	
	Renovation	
What was the type of project contract model?	General Contract	
	Project Management Contract	
	Alliance	
	Build and design	
	Splitted contract	
	Something else	
	I can not say	
	Free comment:	
What was the procurement / implementation type of operating rooms?	Traditional model, built in place	
	Total delivery of the operating room (1 supplier incl. Walls, doors, incl. Building services)	
	Total delivery of the operating room (1 supplier incl. Walls, doors, etc. (the hall's Building services traditionally built)	
The phases of the construction project according to HJR12 and TATE12 are: Needs assessment, Project planning, Design preparation, Proposal planning, General planning, Building	The definitions and steps are familiar to me	
	The definitions and steps are partly familiar to me	
	The definitions and steps are not familiar to me	

permit tasks, Implementation planning, Construction preparation, Construction, Commissioning, Warranty		

Questions related to operating room design	**Answers (select one of the options)**	
1. The floor height of the operating room should be defined no later than	Project planning stage	
	Design preparation stage	
	Proposal and general design stage	
	Implemention design stage	
	I cannot say	
	Free comment:	
2. The floor area of the operating room should be defined no later than	Project planning stage	
	Design preparation stage	
	Proposal and general design stage	
	Implemention design stage	
	I cannot say	
	Free comment:	
3. The number of operating room doors should be defined no later than	Project planning stage	
	Design preparation stage	
	Proposal and general design stage	
	Implemention design stage	
	I cannot say	
	Free comment:	

4. The wall structures of the operating room (clean room structure or gypsum board, etc.) should be defined no later than	Project planning stage	
	Design preparation stage	
	Proposal and general design stage	
	Implemention design stage	
	I cannot say	
	Free comment:	
5. The floor surface material of the operating room should be defined no later than	Project planning stage	
	Design preparation stage	
	Proposal and general design stage	
	Implemention design stage	
	I cannot say	
	Free comment:	
6. Selection of operating room support structures (e.g Roof perimeter) should be defined no later than	Project planning stage	
	Design preparation stage	
	Proposal and general design stage	
	Implemention design stage	
	I cannot say	
	Free comment:	
7. 3D modeling of the operating room should be started no later than	Project planning stage	
	Design preparation stage	
	Proposal and general design stage	
	Implemention design stage	
	I cannot say	
	Free comment:	

8. The cleanliness level of the operating room (Clean <100 CFU or Ultra Clean <10 CFU) should be defined no later than	Project planning stage	
	Design preparation stage	
	Proposal and general design stage	
	Implemention design stage	
	I cannot say	
	Free comment:	
9. The method of ventilation of the operating room (recirculated air + fresh air / fresh air only) should be determined no later than	Project planning stage	
	Design preparation stage	
	Proposal and general design stage	
	Implemention design stage	
	I cannot say	
	Free comment:	
10. The air distribution method of the operating room (mixing / diluting vs. Laminar) should be defined no later than	Project planning stage	
	Design preparation stage	
	Proposal and general design stage	
	Implemention design stage	
	I cannot say	
	Free comment:	
11. The number of operating pendants, arm monitors, etc. should be defined no later than	Project planning stage	
	Design preparation stage	
	Proposal and general design stage	
	Implemention design stage	
	I cannot say	
	Free comment:	
	Project planning stage	

12. The number and types of operating room pass through cabinets (on shelves, trolley etc.) should be defined no later than	Design preparation stage	
	Proposal and general design stage	
	Implemention design stage	
	I cannot say	
	Free comment:	
13. Principles for operating room lighting should be defined no later than	Project planning stage	
	Design preparation stage	
	Proposal and general design stage	
	Implemention design stage	
	I can not say	
	Free comment:	
14. The locations of the operating room's telecom and electrical centers should be defined no later than	Project planning stage	
	Design preparation stage	
	Proposal and general design stage	
	Implemention design stage	
	I cannot say	
	Free comment:	
15. The equipment loads of the operating room electrical center should be defined no later than	Project planning stage	
	Design preparation stage	
	Proposal and general design stage	
	Implemention design stage	
	I cannot say	
	Free comment:	
	Project planning stage	

16. The number and location of operating room technology outlets (electricity, tele, data, AV, gas) should be defined no later than	Design preparation stage	
	Proposal and general design stage	
	Implemention design stage	
	I cannot say	
	Free comment:	
17. Radiation protection in the operating room should be defined no later than	Project planning stage	
	Design preparation stage	
	Proposal and general design stage	
	Implemention design stage	
	I cannot say	
	Free comment:	