Reducing hospital cost through better design

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IHF WORKING PAPER

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In memory of Romano Del Nord

The White Paper "Reducing hospital cost through better design" is dedicated to the memory of Romano Del Nord.

With the writing of this document the Interuniversity Research Centre TESIS, the International Hospital Federation and the Public Health Group of the International Union of Architects have decided to give continuity to the project which Romano, who died prematurely, could not see to completion.

Certainly, he was the creator and main force behind this initiative.

Romano was the founder and director of TESIS and distinguished member of the IHF and UIA-PHG. Within these institutions and thanks to his strong relationships, Romano cultivated the idea of making a contribution to the advancement of design culture in the field of hospital architecture internationally.

Romano represented passion, dedication and excellence in research, education and professional activity. Health care architecture was always at the centre of his interests and his commitment was so strong that he reached the most remarkable results in the development of design culture. Hospital design was the main field of research through which Romano contributed not only to the advancement of knowledge, but also to the practical application of innovative tools and methods for architectural design and the building process.

The scientific and methodological rigour, the continuous search for innovation, and the pragmatic effectiveness of outcomes are the main characteristics of his approach. The important roles Romano played in many institutions at both, national and international levels, testify to the greater consideration of all the people he touched.

For this reason, Romano held a privileged point of view, looking at the complex world of architecture and construction from above and from different perspectives. His capacity to clearly and objectively read and understand the phenomena, and his capacity for strategic vision arises from that particular condition, besides his personal clarity of mind, perspicacity and authority.

Romano was always very happy to participate in UIA-PHG and IHF meetings: for him it was a delightful occasion to meet his friends and colleagues, not only to share knowledge and culture, but also to enjoy a true moment of friendship.

Executive summary

Problem: The cost of delivering healthcare, and the construction of healthcare facilities, are increasingly important issues throughout the world in developed, developing and emerging countries. The overall cost impact and total life cycle cost of a capital investment in healthcare infrastructure is rarely understood, captured or considered when making decisions regarding the construction of new hospitals and healthcare facilities, or the renovation and expansion of existing facilities. Capital project budgets and decisions typically do not consider the ultimate costs of a project including its social costs, environmental impact costs, operational costs in terms of both resources and labor, or their renovation, expansion or replacement costs down the road. Life cycle costs are difficult to capture as they occur over long periods that outlast the decision makers, designers and operators involved in initiating and implementing any given project. The first challenge is to identify all the potential life cycle costs of a healthcare project.

Premise: The goal of this initiative was to develop a framework and tool that organizations around the world, in both the public and private sector, can utilize to identify, capture and assess life cycle costs of healthcare projects through case studies, best practices, and other resources. The intent is to assist design and operational decision makers in planning, designing and implementing and operating better hospitals to provide more efficient and higher value and quality care over the life cycle of a capital investment.

Process: The IHF, UIA-PHG, and TESIS representatives identified professional and academic experts with a cross section of skills, knowledge, and personal experience necessary to develop “wisdom” in the form of best practices. A series of workshops and meetings were organized for the purpose of discussing the challenge of hospital cost savings, the first of which was held in 2014 in Florence. Other workshops were organized in Geneva (2015), Salvador (2016), Durban (2016), Manila (2017) and Paris (2018).

Product: The results of this initial effort attempted to first define the critical issues and dimensions of the total cost impact and life cycle costs associated with the design, construction and operation of hospitals and healthcare facilities. It then defined a framework for capturing these costs, as well as identifying the constituencies involved or responsible for costs at different points in a project life cycle. One case study project illustrating an earlier decision framework in included in the appendix. The ultimate objective of this white paper is to introduce a program that could eventually be translated into a digital platform for sharing best practices about ways to reduce hospital costs through better design.

1. Background/issues

Health is a major concern to all, but access to appropriate health services is still far from the norm for a large portion of the population on the earth. The international commitment to Universal Health Coverage[1] (UHC) adopted by the United Nations reflects this major priority for the world population.

In order to have universal access to health, three components are necessary: funding for health services, an adequate number of trained health professionals to deliver them, and the facilities required to provide the care.

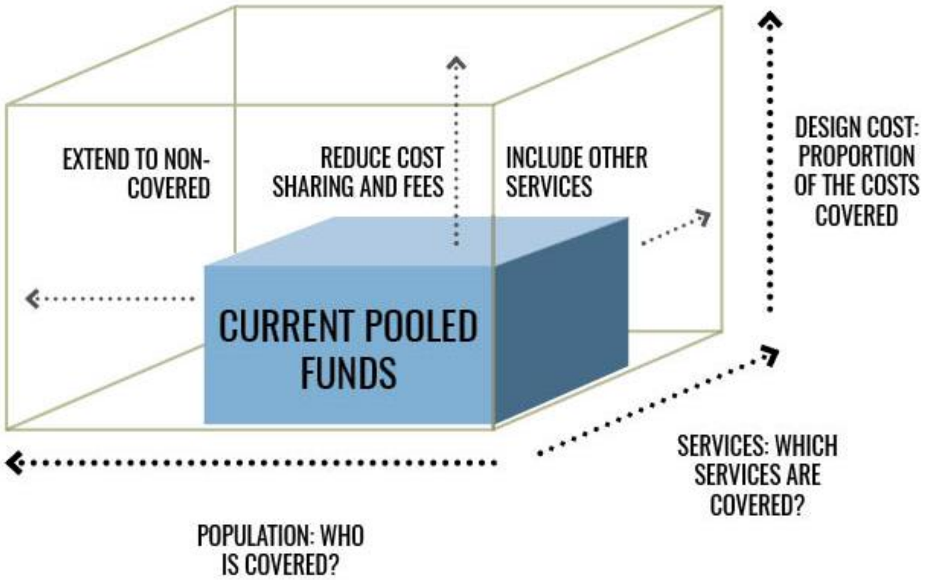

Figure 1: Three dimensions of Universal Health Coverage[2]

A lot of attention is focusing on funding health services beyond an individual's or family's capacity to do so through collective approaches such as private health insurances, social health insurance, and government funding. The major issue is to be able to pool resources in order to enable people in need to have access to care, especially for situations requiring major life saving interventions.

Concern regarding a shortage of health professionals has been ongoing and increasing for many years, and many initiatives have been taken to respond to this situation. Improvements have been made in some contexts, but there is still a long way to go in order to provide adequate coverage for populations around the world[3].

The third element of UHC, the adequate planning, coordination, and commitment to resources and settings for the provision of services, is an issue that has not been

[1] Joint vision for UHC - https://www.uhc2030.org/our-mission/joint-vision/
[2] World Health Report 2010 - https://www.who.int/whr/2010/10_chap01_en.pdf?ua=1
[3] Global strategy on human resources for health http://apps.who.int/iris/bitstream/handle/10665/250368/9789241511131-eng.pdf?sequence=1

adequately addressed. Obviously, global advocacy for more effective primary care is part of the renewed commitment[4] to Alma Ata Principles and is a key element for access to essential health services. However, essential primary care services cannot address the overall health needs of populations; follow up or referral care including acute care is also necessary for the treatment and cure of the most critical episodes of diseases and accidents.

Although there is no international definition for hospitals, they are the facilities that are necessary to host referral, specialty, acute and critical care. Hospitals can be different in nature and size, but they require a significant investment in appropriate and adequate infrastructure. The planning, design and construction of health facilities, and especially hospitals, has not drawn much attention from public health leaders and is most often not part of policy discussions around Universal Health Coverage.

On the other hand, governments often put forward the design and construction of hospitals as the visible face of their healthcare service delivery to the community. Most often, this is done without any solid empirical evidence on the need for and relevance of a hospital in the selected location and the appropriateness of services to be provided in response to public health priorities in the country.

In many emerging countries, the private sector has been investing in the design and construction of hospitals to support the provision of services to a fast growing middle and upper class with increased affluence and demand for health services. Countries like Thailand, often quoted as an example for its extension of universal health coverage, have, over the same period, witnessed an unprecedented growth in the number of hospitals during the period of coverage expansion.

[4] Declaration of Astana on Primary Health Care https://www.who.int/docs/default-source/primary-health/declaration/gcphc-declaration.pdf

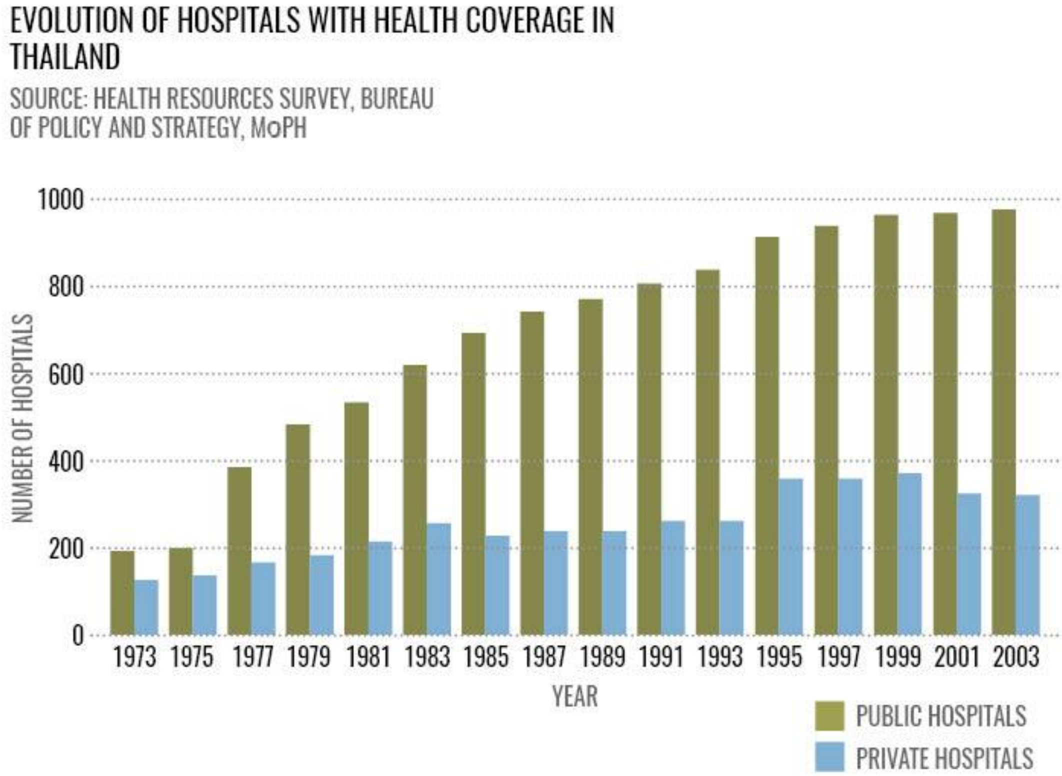

Figure 2: Evolution of hospitals with health coverage in Thailand[5]

In advanced countries, the design and building of additional hospitals is less dramatic, yet there remains a significant need for the construction, expansion, and renovation of hospitals to be able to adapt to the changing demands of evolving patient care practices and technologies, evolving demographics in the populations being served with the overall global migration of people from rural to urban areas, and the practice changes which are driving greater outpatient care and shorter lengths of stay.

Taking all these trends together suggests that planning, design, and construction of new or renovated hospitals is a key component of the health agenda of all countries even though this is typically not put forward in policy discussions and is barely ever raised in the international arena.

It could be argued that there is no need to address the design and construction of hospitals in the health policy agenda because this is viewed as simply a technical matter that is well mastered due to the numerous hospitals that exist and have been recently built. On the contrary, this is exactly where greater effort should be placed, and there are good reasons for this.

[5] http://www.ilo.org/wcmsp5/groups/public/---ed_protect/---soc_sec/documents/publication/wcms_secsoc_6612.pdf

Typically the promotion of primary care is the primary concern of health advocates who argue that hospitals can be a waste of resources when they are not responding appropriately to health priorities of a given population, or have a very low utilization rate because they are not located in relevant places. These concerns can be addressed when hospitals are properly planned and designed, having in mind operating costs from the start of a project the operating costs and how they could be optimized for improved efficiency and maximum health outcomes. Such a design cannot result from a “copy and paste” approach with standardized health facilities. There have been many efforts to develop such standardization, but results have been mixed. Having technical norms is useful to guide hospital construction, but having standardized hospital designs have generally been a failed approach globally because a standard hospital rarely, if ever, fits with the specific needs of a place and a population. In addition, evolving needs and care practices occur at a faster pace than the capacity to develop, and eventually update, hospital facilities. Standardized hospitals are the best recipe for failure in health service provision: inappropriate services at an unacceptable cost.

Urbanization all around the world is occurring rapidly, making hospitals an adequate response to the increasing healthcare needs of people in densely populated areas. It is then important to have the planning and design of hospitals that are relevant to the needs of the populations served, that are efficient, and that provide the best quality of care in a patient centered and safe environment. This requires special attention to the design of the hospital and an approach that is not just a technical one which can be outsourced to companies that provide turnkey facilities without involving all the stakeholders, as well as those who will be utilizing and operating the facility. Examples of failed turnkey projects are also quite abundant and have led public investors to give up on approaches of the past.

Having a brand new, state-of-the-art hospital is often a dream, or the result of an accomplishment for health authorities as well as for the leadership and staff working in such facilities. It is also sometimes the pride of the population it is serving. But as is commonly said, all that shines is not always gold.

The possible excitement, and eventual pride associated with working within a new place does not last long when what matters most to all is whether it enables the best quality care in the most efficient and patient centered way.

This is when reality hits the dream: very often a beautiful building does not respond to expectations and/or very quickly becomes outdated. This simply reflects the fact that building a hospital is not only about facility design, but is also about operations. If the hospital as an organization is not well planned, then the facility will not succeed in its intended impact of quality, safety and efficiency.

The planning, design and construction of a hospital or health facility is a unique opportunity: let’s not make it a missed opportunity.

Healthcare organizations are facing major challenges to rethink the way they should deliver care. Pressure is accelerating on healthcare providers to be more patient centered and to provide the "right care," in the "right place," at the "right time." This concern is not new. For years, political authorities have recognized the need to curb the cost of providing healthcare services given annual growth rates that regularly exceed Gross National Incomes.

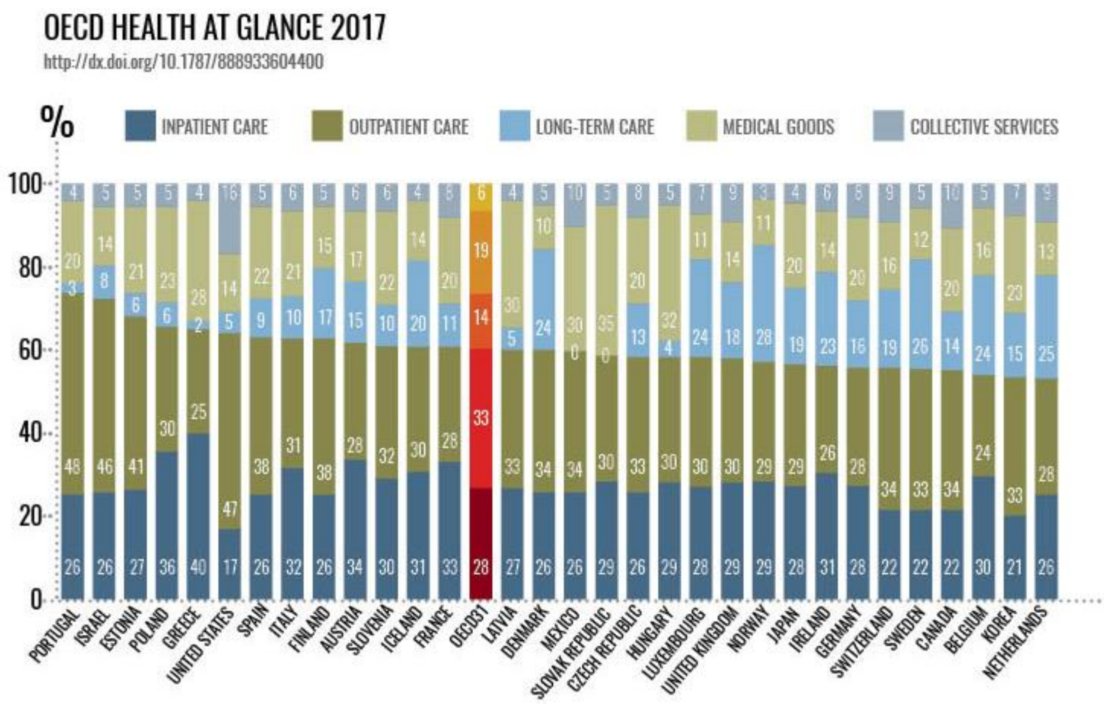

Figure 3: Health expenditure by type of service, 2017 (or nearest year)
OECD Health at glance 2017, http://dx.doi.org/10.1787/888933604400

The 2008 crisis in advanced countries and previous financial shocks in others have placed greater pressure on reducing healthcare expenses, especially when they involve public expenditures in a constrained fiscal space. Additionally, governments in emerging markets are encouraging the growth of the private sector in the provision of hospital care. Available disposable income and increased access to information has caused an increase in outmigration of patients in search of quality and accessible healthcare. Social investors see an opportunity to capture these patients within their native countries by developing higher standard hospitals. This is contributing to a growth in the number of private hospital developments in emerging and developing countries.

It is difficult to foresee how healthcare needs will evolve. In several countries around the world, there is a rapidly growing demand for healthcare services resulting from an aging population having to cope with an increased number of multi morbidity conditions, while on the other hand technology promises new advances in treatment as well as a potential paradigm shift for care delivery with all components of e-Health, innovative medical devices, and predictive medicine as a result of genomic research. Infectious diseases are being replaced by Non Communicable Diseases (NCDs) as primary morbidity and mortality causes, and hospitals continue to be the most expensive venue for providing services.

Having to face greater uncertainty while accommodating a strong demand for more health services requires more than ever that we pay close attention when it is time to build or renovate a large health care facility. In a world of increased mobility and virtual transactions, it is also increasingly critical to make the most appropriate decisions in creating a place that services the needs of the intended populations, as well as a place where health workers can be mobilized.

Hospital planning, design, and construction is therefore not just a technical issue to be guided only by the appropriate knowledgeable professionals; it is also a major matter of health policy and practical functionality in which it is important that all stakeholders are aware of each step and the consequences of decisions on the future of health spending, reduction of waste, and increased quality of care outcomes.

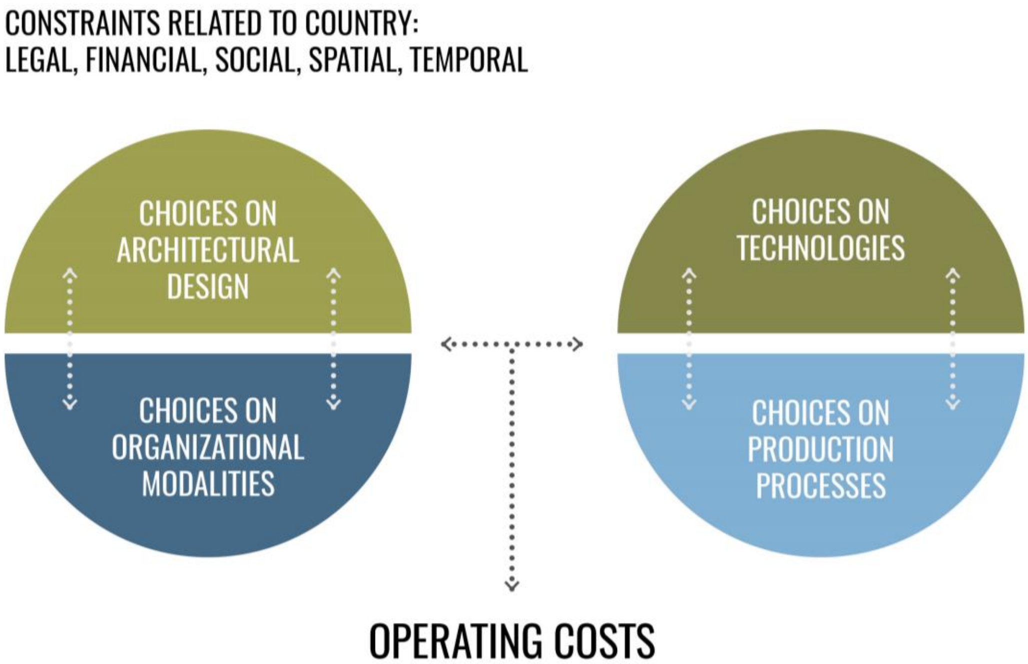

Figure 4: Constraints related to country: legal, financial, social, temporal

2. Objectives and Expected Outcomes

Background

From June 2014 to 2018, TESIS Interuniversity Research Center with the International Hospital Federation (IHF) and the International Union of Architects-Public Health Group (UIA-PHG), joined forces in a common project on "reducing hospital operating costs through better design". This team worked on the development of a methodology to identify cost components in the project design and construction cycle as well as on the methodology for collection of best practices.

The goal of this initiative is to develop a tool which organizations around the world, in both the public and private sector, can utilize to identify case studies, best practices, and other resources that will assist them in better designing their hospitals to provide more efficient and higher quality care over the life cycle of a capital investment

Objectives:

Objective #1: External Scan

To reflect this global perspective, the topic of “containing the operating costs of healthcare facilities through hospital design” needs to be broadly analyzed, from the most technologically advanced countries to emerging and developing countries.

Objective #2: Understanding the Project Phases (Project Delivery Cycle)

Considering the complexity and multiple phases of hospital project delivery, it is relevant to start with an initial grid to guide the decision-making process in order to identify any opportunities for cost containment and allocation.

This requires exploring the project delivery cycle representing the various phases of project delivery and scope of a hospital project, and identifying the stakeholders involved with their respective roles.

The objective is to provide support to a wide range of stakeholders involved in health services delivery, including a better understanding of the phases of a construction project and the related questions that should be considered at each stage of its development.

Objective #3: Create a Guiding Framework

The proposed guiding framework supports a more productive discussion between all parties that should be involved in the decision-making process. It also helps in better focusing discussion on the most relevant matters during the project cycle.

Depending on the nature of the project, a guiding framework can also be supportive to prioritization of objectives for discussion and decisions, especially given they will have potential long-term consequences.

The guiding framework supports the establishment of an "open database" of various experiences and management applications, for obtaining a series of “guidelines and recommendations” to steer hospital design towards containing both the capital and operating costs of the organization.

To initiate the mobilization of contributions to such a database, the working group focused on developing a template to report the relevant information for the guiding framework.

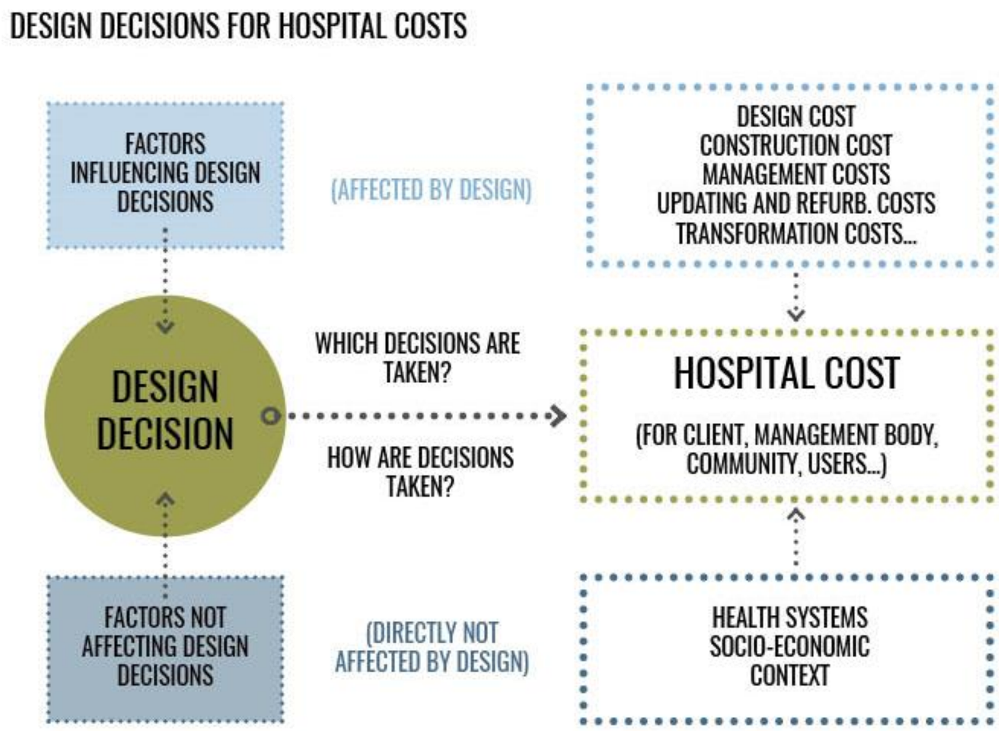

Figure 5: Design decisions for hospital costs

An available guiding framework will be useful for guiding input and dialogue between the diverse constituencies involved in health care decision-making.

<u>Expected Outcomes of the Tool</u>:

Outcome #1: Better Informed Team Members

Public health and health system policy and decision makers have an opportunity to be better informed in relation to strategic planning options. This gives them an opportunity to play a more prominent role in the decision-making process.

Those in charge of managing the facilities can benefit from the guiding framework to make sure that the inclusion of organizational processes are providing the best chances of predicting, managing and mastering operating costs once a project is built.

Outcome #2: More Meaningful Input Throughout the Entire Project Life Cycle

Clinicians who would like to practice at the most advanced levels while responding to efficiency and quality constraints will be better enabled to contribute in the most appropriate stages of the project development.

Community representatives and patient association members can increase their voice with more appropriate interventions, if fully aligned with the guiding framework stages and cost factors.

Architects and engineers, despite likely being very familiar with hospital project delivery cycle, will also find the guiding framework a useful reference for operational impacts, which can help guide the project towards successful delivery of an efficient facility.

Overall, the guiding framework is intended to provide a useful tool to facilitate productive dialogue between all stakeholders around a shared methodological approach.

3. How was this project developed

Given the primary objective of developing buildings that align with operational efficiencies, the IHF, UIA-PHG, and TESIS representatives identified professional and academic experts with a cross section of skills, knowledge, and personal experience necessary to develop "wisdom" in the form of best practices.

A series of workshops and meetings were organized for the purpose of discussing the challenge of hospital cost savings, the first of which was held in 2014 in Florence. Other workshops were organized in Geneva (2015), Salvador (2016), Durban (2016), Manila (2017) and Paris (2018).

Participants in the meetings shared their experiences and expertise to identify critical domains to explore for cost reduction and formulate "recommendations" on the ways forward with this project.

- IHF representatives contributed to defining components of management and maintenance costs that drive, and are impacted by, design decisions as well as savings viability.

- UIA-PHG representatives contributed to defining the conditions required in the development of design proposals to achieve the objectives of cost containment, with particular attention to operational and utilization costs.

- TESIS representatives provided guidance on developing a more rigorous and scientific vision for the study, and defining a matrix for systemizing cost items throughout the life cycle of a Hospital Building and the different phases of the process.

Those involved in this project worked together using the following approach.

- Initial scoping meeting relied on brainstorming to identify the various parameters of the problem and most important drivers to include in the project. This discussion involved determining which drivers to take into account, and the instruments with which to measure them.

- Initial findings were evaluated in a Delphi Approach with additional professionals and academics not involved in the initial stage. This occurred over several iterations of the cost factors with respect to the phases of the project life cycle. Participants addressed how to best integrate cost factors with project cycle components.

- Several team members in various international conferences around the globe helped evaluate a framework for identifying, considering, and classifying cost factors over the entire project life cycle. This provided valuable feedback and triggered a significant level of interest.

- A final meeting was called with initial participants and external experts for consolidation of the work around the definitions supporting the matrix.

In more operational terms, recommendations and discussion specifically focused on:

- Methods and decision-making to be taken to contain investment costs through design decisions;

- Methods and decision-making to be taken to contain operation and management costs;

- Methods and decision-making to be taken to maintain, update, and transform hospital facilities.

It was also determined that potential decisions have to take into account different socio-economic contexts and major variances in the way health systems are set up in different countries, as well as the potential variances between the public and private sector.

The backbone of the project was supported by the academic team of TESIS, around Professor Romano Del Nord, that gathered supportive information from the literature and worked on elaborating the concepts developed by the working party.

4. The scoping of issues

A hospital is first and foremost a community organization and asset that serves the public and is part of the community life. This is valid for both public and privately run hospitals in countries where care is funded by social health insurance or public expenses alike. However, hospitals must also act as well-functioning and well-designed organizations to ensure optimal delivery of healthcare, where efficiency and quality are the drivers. Cutting costs cannot be an ultimate goal for efficiency when designing a hospital.

The objective when designing a hospital should rather be to raise the total level of social capital through the establishment of an effective and integrated health service provision. From that perspective the question is: “What does a hospital need to do to improve its social capital?”

The design process should always place emphasis on ongoing dialogue with key stakeholders: health workers at all levels, patients and their families, the administrative team, and the communities being served. It is important to involve clinicians, especially at early planning stages, aligning in advance both clinical and economic objectives to be pursued. All stakeholders should be aware of the cost implications of any proposed option. It is also important to recognize the specific cultural context, as it frequently dictates users’ expectations.

Healthcare Systems Planning

An important aspect of cost containment is the relationship between the hospital and other healthcare facilities. Cost containment cannot be viewed solely from the perspective of a single hospital’s operating cost, but rather from the perspective of the overall system.

For this reason, the concept of a “hospital without walls” has been introduced into the discussion. This has previously been suggested under various circumstances, but should now become mainstream; it forms the foundation for the concept of a network of health providers, making hospitals open to the community and playing a pivotal role as a civic institution.

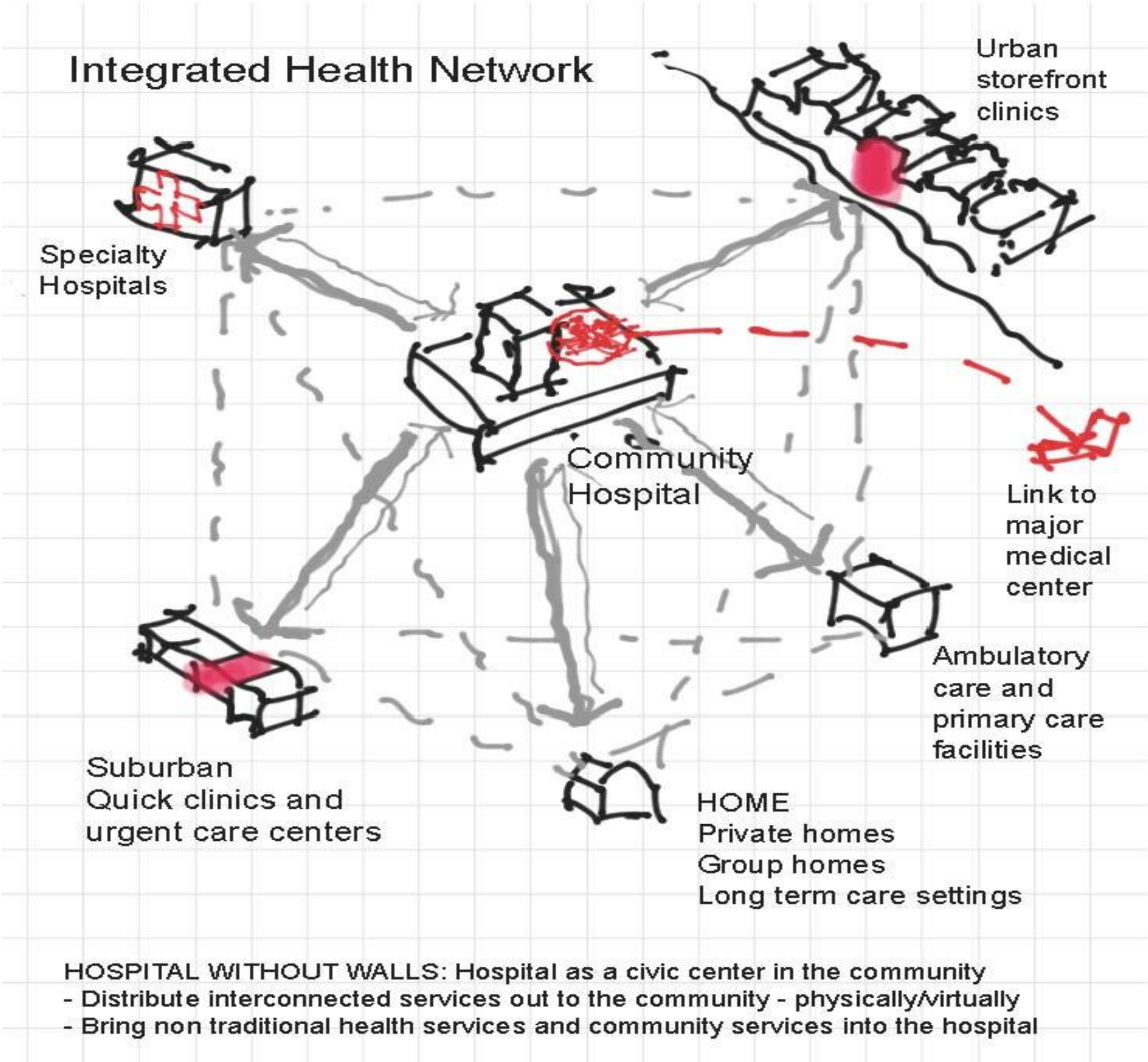

Figure 6: Hospital without Walls

Hospitals must not act as shops for organ repair, but rather promote patient-centered care supported by healthy lifestyle choices. Since overall costs should also consider the consequences of morbidity and disabilities, it would be necessary to bring into the discussion the cost impact on the health of populations. Healthcare and social care have different stakeholders, but the distribution of role and responsibilities between these two is shifting, and the relationship between the two varies depending on countries. The risk of a project only focused on hospital operational cost reduction is that it could ultimately impact the cost of social care, eventually ending up with higher overall costs for the community. Social costs should not be considered separately from healthcare expenses (especially with regard to the aging population).

It was recognized that most hospital projects do not take into account all these dimensions because decision makers are inherently inclined to focus on a specific project, as well as the source of funding. This is not supportive of a holistic approach to hospital construction in an integrated way for reducing operation costs.

Healthcare Innovations and Project Life Cycles

The planning of hospital projects often attempts to take into account future needs by accessing the most recent information; however, acceleration in healthcare innovations creates growing uncertainty. Responses to recognized needs are only effective for a limited time span. This is a major challenge with construction projects. The timeline for moving from an initial concept to delivering a building ready to use is long, difficult to reduce, and comes with the risk of delivering a new hospital that is almost out of date. In addition, in most countries the depreciation of construction is on a period between 15 to 25 years (and in some places up to 50 years), while it should be calculated over a period of no more than 10 years. All these issues can be summarized by the following figure on total life cycle cost.

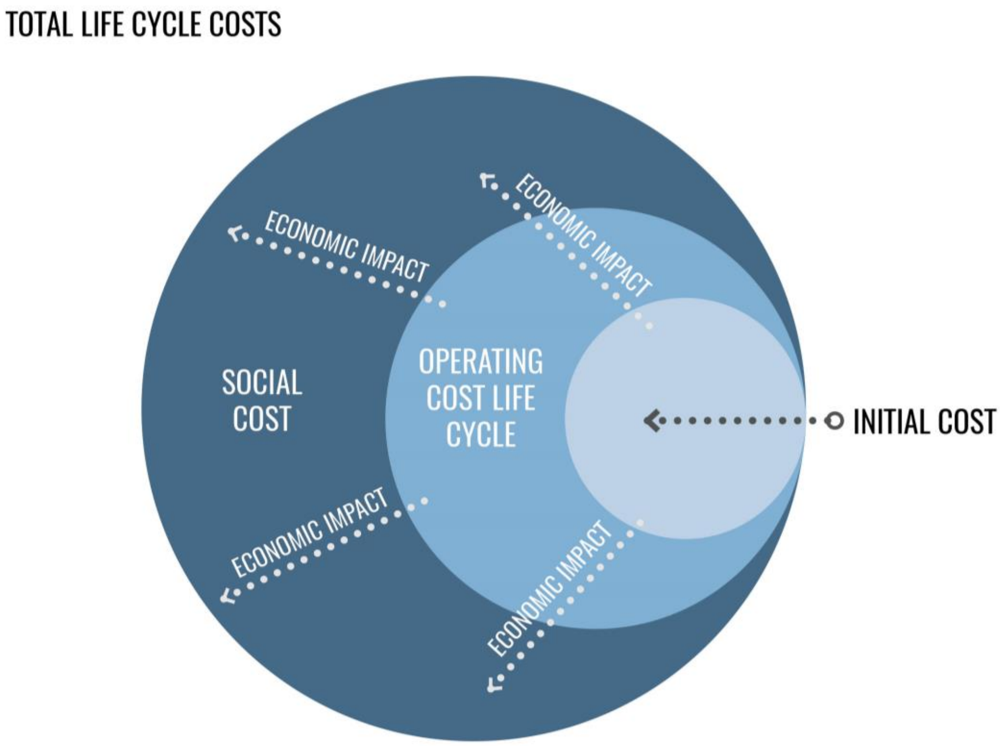

Figure 7: Total Life Cycle Cost.

There is a large portion of cost that is under social cost. Social cost cannot be well identified in a generic way and in a global perspective. For this reason, the work has focused on the project process of individual hospitals. It is recognized that this is not enough but, at this stage, it is also important to have this portion of cost well mastered by those in charge of hospital projects, as there are already many opportunities for cost reduction and an even greater risk of waste of resources.

5. Identifying project phases

Depending on country of origin, the definition of project phases may be different and may be impacted by local regulations, especially for public projects. The working group discussed how to adopt a generic classification of the phases that could be applicable for any country and context. The parties involved in the various phases, and their components, may vary from country to country, as well as between public and private sponsored construction. However, regardless of the parties, it will be important to rely on the relevant technical expertise, usually in the hands of architects and engineers, as well as the functional expertise of operators who can provide insights on the functional implications of design decisions.

Pre-programming

This is the first stage of the project. During pre-programming, the focus of effort is on visioning for the project. In this effort, the owner/project sponsor defines the project goals:

- The community to be served and target market within the community;
- The location in relation with urban development perspectives;
- Whether an existing owned or purchased facility is involved;
- The scope and mix of services in relation to health needs and existing services;
- The type of organization and delivery model;
- The process for selecting the architect in relation with country regulation;
- The modalities for funding the project and operating the facility;

All of the above information helps define the “vision” of the organization, which is utilized as the basis for the feasibility study, during which assumptions and projections are made based upon the pre-programming framework to determine if the project is viable, sustainable, and, ultimately, fundable.

Feasibility Study

The Feasibility Study of the building life cycle follows the pre-programming phase and precedes development of the project program. It serves to explore and record the technical, social, financial, and economic viability and value underpinning the project, so that the relevant investor/ client/ authorities can make an informed decision on whether, and how, to proceed with the proposed project. Ultimately, the feasibility study informs the project sponsor, investors, and financiers as to the financial viability of the initiative, projected break-even and profitability timeframes, and anticipated magnitude of capital investment. Feasibility involves incorporation or confirmation of the priorities and objectives of the client, as well as the needs and scope identified in pre-programming phase. It typically includes further articulation of requirements, identification of constraints, and applicable legislative frameworks; outline feasibility (pre-feasibility); substantive feasibility; and order of magnitude estimate of project costs. This phase can include identification and appraisal of alternatives and options, with recommendations.

The feasibility phase includes:

- Conformity with all legal and technical requirements or standards
- Technical feasibility: functional and technology options
- Implementation conditions: climate, geological, and site analysis
- Sustainability objectives (energy and carbon footprint)
- Business model (costing and financing) including cost benefit analysis and financial projections
- Gap and competitor analysis
- Operational model and level of outsourcing
- Program considerations regarding timeline and activity relocation
- Project execution plans identifying critical phases
- Master planning as recap of the functional program
- Procurement options

Feasibility studies conducted during the initial design stage are theoretically standardized to address the same issues in the same way, limiting variation. However, they are often interpreted differently by each stakeholder, which complicates efforts to effectively coordinate the process and end product.

Typically, a feasibility study is commissioned by the project sponsors (in the case of a public hospital, the government; in the private sector, the majority investor). The study serves to define for the sponsor/investors whether the project has merit within its designated community, what the capital expense (CAPEX) will be, what magnitude of investment is required, whether the hospital is self-sustainable, and in what year does it break even or become profitable. This study is of particular importance to commercial banks, development banks, and others who may finance the initiative as it allows them to identify and mitigate potential risks should they decide to invest.

Project Program

The project program is one of the outputs of the feasibility study and serves as an input of the design phase. It may serve as a term of reference with the designer about the intervention to be undertaken. It provides a performance definition on the work to be realized.

The "project program", in detail, guides how to develop the different phases of the initiative, the design drawing of the project, and the specification of the building process in relation with the work assignment. It allows the owner to manage the programming activity in parallel with the design process, as long as there are project margins clearly defined. The “project program” incorporates the ideas that emerge following the development of the preliminary/ definitive project in order to achieve additional functional or qualitative goals, and to ensure that resources are compatible with the goals. Additionally, it will address any issues that are generally caused by conflicting constraints or needs among the main decision-making areas (evolving dynamics of costs and timing of intervention, significant changes in design, users’ dissatisfaction, etc.). It is a dynamic and flexible document.

The most significant elements of the project program are scope of health services, general organizational choices, indicators and standards, urban infrastructure system, urban and building constraints, technical and design constraints, the criteria adopted, the functional and space program along with an estimated budget.[6]

Investment costs must take into account civil works, plant, equipment, furniture, unforeseen expenses, technical costs for the area, external works, utility connections, VAT.

To achieve a comprehensive project program, it is wise to consider the need for:

- an exhaustive documentation and analysis of the status of any existing hospital facilities (reutilization of existing buildings);
- a clear and unequivocal expression of the demand in the functional program: it could be satisfied through a clear differentiation between required and recommended;
- reliable data relevant to the project: surfaces (is this square meters?), equipment, number of beds, number of healthcare services delivered, average length of stay, bed turnover, number of healthcare workers, work organization etc.;
- an accurate evaluation of projected operating cost and volume of services;
- the intermediate objectives and priorities in the timeline;
- the qualitative target of the building through the combined expression of the performance specifications and the estimated costs;
- guidance parameters for the achievement of energy saving and environmental sustainability objectives.

The project program should actively interact with the next stages of the building process so that it can directly manage and mitigate for project failure, or lack of detail; this need can be met through the use of "integrated design approaches," such as those offered through BIM.

[6] (Giovenale, Il progetto preliminare nell’edilizia ospedaliera, Edizioni Kappa, Roma, 1998, pp.147-152).

The analysis[7] of compliance with urban planning tools and context constraints (in relation to landscape, archaeological, geological, water, and seismic conditions) is important for the choice of the hospital location. The synergy with other facilities that are part of the network of health services must be considered in relation to communication and transit infrastructures.

Conceptual or Schematic Design

Conceptual design defines the basic form and organization of the project. It involves both an analysis of the different flows for all categories of users, and by consideration of the horizontal and vertical connection nodes between the various levels. With reference to the proposals to optimize the whole system, it is possible to summarize the following aspects:

- main indicators (beds / surfaces / ...);
- proposed health organizational model (e.g., departmental structures);
- proposed articulation of hospital macro-areas [IE: departmental block plans];
- building characteristics and its lifespan;
- building plan, volume and façade definitions;
- flow identification and management;
- accessibility (handicap) requirements;
- estimate of whole project costs;
- estimate of the maintenance of the building and infrastructure;
- timeline requirements;
- phasing of the construction and the financial implications;

Design Development

This phase represents the translation of the project into the full technical requirements for the construction, including detailed graphic design and cost estimates. It contains detailed descriptive documents for each of the building system.

In most countries there are two distinct phases: the first one aims at getting a formal approval from the authorities in charge of construction and/or hospital projects in the country. The second one is more detailed, and it aims at completing the construction bidding, as well as the follow up from construction to commissioning. This later phase involves preparation of the contractual documents for the construction process.

The level of details in the second phase description will vary according to the available regulations or practice standards. In countries with detailed regulations, the design development documents may simply refer to these regulations and standards. In

[7] (Giovenale, Il progetto preliminare nell'edilizia ospedaliera, Edizioni Kappa, Roma, 1998, pp.137-146).

countries without such regulations, it will be appropriate to include all relevant details as part of the design development documentation.

Design development usually requires mobilization of different professional capacities in addition to the architects, some of which may be required due to construction insurance modalities and regulations.

The second phase of design development identifies:

- Details of choices for utilities and their implementation;
- The heating ventilating and cooling system;
- The structural characteristics (fire, seismic, foundation,);
- The building elements;
- The requirements in relation to equipment and utilization of surfaces;
- The interior and exterior systems and materials for the finishing;
- The choices for lighting;
- The contractual requirements for technical prescriptions, timelines, and costs;
- The furnishing and its implementation in the buildings;
- The technical equipment, including biomedical devices;
- Exterior and landscape setting (roads and parking, green zone, etc.);
- Signage solutions and implementation; and
- Life cycle assessment of all components for the building (sustainable development)

These five phases will have some variations by country but can be considered as quite applicable for any project, whether it is a greenfield project or an intervention on an existing site. Once the design development phase is completed, the procurement of services for construction is often executed. However, a growing project delivery process involves “integrated project delivery,” where the construction or construction management company is contracted and involved in earlier phases of the project delivery process along with the planning and design consultants.

The rules for procurement vary significantly between countries and between the public/private sector. For this reason, it is difficult to include the construction phase in this document as it is relevant in any part of the world.

Construction

During the construction, there may also be decisions having consequences on the construction costs and on the operating costs. However, considering the size of a hospital project, these costs will remain modest so long as they are marginal and do not profoundly change the design development phase instructions. The mechanisms for making decisions during construction phase will also depend on the local regulations applicable in the specific country for construction supervision. In addition, these occur on various occasions that are not easily incorporated into a systematic process description.

6. Identifying costs factors

Cost Estimation and Containment

Especially in countries with a robust public investment in health infrastructure, policies based on “standardized costs” tend to define the maximum cost compatible with each service, in order to keep expenditures within the fixed budget. This is a frequent approach in the public sector. Standardized cost is established from a database of past projects. This is a way to better predict project costs and avoid unreasonable projects for the purpose of the hospital. However, such an approach is based on historical data and rarely allows reconsidering the functions of a hospital in an innovative and forward-looking approach. These models only address project delivery costs, and do not adequately capture the importance of choices that affect life cycle costs. It is a false security in a bureaucratic mindset if first cost is the only driver for cost containment. It can be useful if only used as a reference for benchmarking while considering all alternatives for cost reduction according to the objective of projects.

In current projects, it is common to rely on Building Information Models (BIM).

The Building Information Model (BIM) aims to contain costs in the design process. The principal objectives are:

- to check the best design solutions by comparing them with the opinions of various stakeholders (doctors, nurses, health personnel, etc.) (Collaborative design method).
- to check the design solutions adopted in specific areas of the project, such as energy containment, safety, system components, using a shared project verification system (Integration between processes).
- to avoid errors and to guarantee the correct alignment of the information and elaborations produced by the various project delivery participants including architects, engineers, construction managers, contractors and subcontractors in order to achieve greater efficiency and productivity.
- to manage BIM Models in an integrated way with Computer Aided Facility Management (CAFM) systems, in order to reduce the operating and building management costs (greater efficiency in the management of the building life process).

Outsourcing

The outsourcing of services strongly affects decisions in the project cycle. If outsourcing is broadly adopted, it may reduce a significant number of functions in the building (for example, no kitchen/laundry facilities on site). In this case, it will be difficult to bring back such functions later on, because the project design will have been executed without them. Having buildings with a high level of flexibility for potential additions, expansions, and replacement of functions may also be a factor of additional cost. Utilization of BIM can allow design and integrated project delivery teams to estimate the cost of different configurations according to the level of outsourcing.

Scale

A major question that is raised at an early stage of a hospital planning, design, and construction project is that of determining the optimal size of the project, as this is closely linked to the potential economies of scale. Scale efficiency is defined as the ability to achieve optimal production in terms of use of resources with lower unit costs.

Identifying the optimal size of a hospital is difficult because if a large health facility can ensure a high volume and important spectrum of health services, it can also generate diseconomies of scale. On the other hand, a smaller and more efficient structure can present operational fixed costs disproportionate to its size. Studies in recent publications, which take into account various factors that contribute to a synoptic evaluation (functional, organizational, structural, economic factors, etc.), reported consistent evidence of economies of scale in European countries for hospitals with 200–300 beds. Diseconomies of scale can be expected to occur below 200 beds and above 600 beds.[8] This may vary in other social, political, reimbursement, and physical contexts.

Technologies

Evolution and advances in information and medical technologies bring increasing uncertainty for the future needs and natures of hospitals. These advances can affect the way care is organized and delivered, as well as the type, nature and size of the building to accommodate patient care. There are also a number of technical consequences on the infrastructures related to these evolutions. The major challenge is to bring on-board technologies that may still be in the early stage of development at the beginning of the decision-making process. The challenge is balancing the risk of adopting a technology that will not deliver its promises versus potential additional cost of an existing technology, or even adding a new technology later on. Therefore, it is wise to plan hospitals so that they can easily adopt and incorporate technology development at the early stage of the project before the actual construction starts, despite the fact that this may bring some additional costs.

Cost Categories

In order to better identify cost factors, they are broken down in several categories related to the design process as follows:

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[8] Monica Giancotti, Annamaria Guglielmo, Marianna Mauro, "Efficiency and optimal size of hospitals: Results of a systematic search" PLOS Published: March 29, 2017 https://doi.org/10.1371/journal.pone.0174533

- Professional costs: Costs for the planning and preparation of documents (from the feasibility study to the post-occupancy evaluation, including the site safety and security plan), administrative and legal expenses, planning costs, costs for contingencies;
- Building project costs: Including all costs from the possible need to purchase land, to the actual cost of materials and labor to construct the building, the cost of major fixed and movable equipment and furnishings, to the commissioning of the building. They may also include demolition costs when new construction takes place on a site that is already built;
- Infrastructure costs: For all that relates to the connection of the buildings with the existing utility and transportation infrastructure. This may also relate to the development of green space;
- Operating costs (or operational cost): This is the largest category of cost, as it represents all expenses that will be incurred to operate and maintain the building, including staffing and materials to support patient care and general operations;
- The cost of accommodating change;
- Social costs: These are very important, but difficult to measure because they are related to all the users of the facility as well as to the impact of the facility in both its immediate and extended community context.
- Sustainability costs: A category of cost that will have more and more importance with the climate change engagements from communities and countries. It may also be a source of revenue in an extended carbon market.
- Opportunity costs: Can be considered intangible, but should be considered in terms of the cost of lost opportunities during a decision discernment process.

A. Professional costs

Professional costs[9] can be divided into costs relating to preliminary studies, costs relating to investigations, costs relating to the design work, and costs relating to the post-design phase.

[9] Costi per la redazione di studi di fattibilità, costi per le fasi iniziali di briefing, costi per la raccolta dati relativi agli user requirements, costi relativi alle indagini di impatto ambientale, costi relativi ai rilievi di carattere ambientale (di tipo acustico, illuminotecnico …), costi per le indagini urbanistico territoriali, costi per le consulenze economiche e gestionali.

Costi per le fasi di indagini; costi per i rilievi riguardanti gli aspetti inerenti alle condizioni geologiche e geotecniche, costi per le indagini relative al rilievo dei sottoservizi delle infrastrutture, costi per il rilievo degli edifici (in caso di ristrutturazione o ampliamento).

Costi per la progettazione: costi per lo sviluppo delle fasi iniziali di progetto, costi per la definizione del piano di progetto, costi per lo sviluppo del progetto, costi per le procedure di verifica e di validazione dei progetti.

Costi per la fase di post progettazione: costi per la direzione dei lavori, costi per il collaudo, costi per la direzione dei lavori, costi per il collaudo delle opere, costi per la certificazione della qualità,

- **Costs for preliminary studies are for:**
  feasibility study;
  initial briefing phase;
  collecting data relating to user requirements;
  environmental impact analysis;
  urbanistic-territorial constraints investigations;
  health planning and consulting activities;
  economic and management consultancy services;

- **Costs for investigations are for**:
  geological and geotechnical analysis;
  environmental measurements (for example: acoustic, lighting measurements etc.);
  infrastructure measurement;
  measuring buildings (in case of renovation or extension).

- **Costs for the design work are for:**
  development of the initial project phases;
  definition of the project plan;
  project development;
  design verification and validation.

- **Costs for post-design works are for:**
  construction management;
  building test;
  quality certification;
  licensing;
  security and commissioning.

B. Building costs

- **Cost of land:** This cost relates to building construction feasibility and the different forms of the surface/area rights' acquisition. It may include costs for purchase of the land and/or cost for use of the land, (leasing, etc.). In the case of transformation, renovation, or retrofit (from an energy point of view), it corresponds with the building value.

- **Cost of phasing:** Costs resulting from the articulation of the building process in stages or in more lots or in time gaps (additional costs related to other cost components).

- **Construction cost value:** All costs incurred for the complete construction of the building, with the exception of the cost items listed below.

- **Equipment cost:** Furnishings and equipment costs, including all fixed and/or integrated equipment (referring to operating rooms, radiology rooms, laboratories, transport systems etc.).

- **Transformation and adaptive reuse costs:** Costs for a complete or partial transformation of a building in order to reach a better use of space, respond to regulatory adjustments, or implement new aesthetic and functional requirements, after initial occupancy.

- **Demolition costs:** Cost of demolition of the building with a complete evaluation of the economic benefits achieved with reuse of recycled materials from demolition.

C. Infrastructure costs:

Costs for the construction of basic infrastructure (electricity, gas, etc.) and secondary infrastructure (roads, parking, etc.). In general terms, it refers to all services or systems that must be present at a building site in order for the facility to function and be maintained, such as utilities, roads, and storm water management. It may also refer to all the building services and utilities located "inside the walls," that must be in place before facility can be operational, such as phone and data lines, plumbing, and mechanical and electrical systems.

D. Operating costs

Costs for managing the functionality and services offered in the building after opening.

- **Logistics cost and management cost**: Costs including activities for purchasing, receiving, inventory management, management information systems, telemedicine, food services, transportation, and home care services, etc.

- **Administration cost:** Costs relating to the administrative management of all hospital activities and of all incurred hospital expenses.

- **Medical support cost:** Costs related to medical and professional resources used for the services provided.

- **Patient care cost:** Costs related to human resources for non-medical services provided for patients.

- **Energy costs:** Energy costs in hospital buildings are mainly connected with heating, cooling, and electrical energy vectors. Hospital energy consumption is linked to a number of factors including: site characteristics, orientation, design configuration, construction age, main functions and activities taking place, intensive use of electricity-consuming medical devices, etc. Energy costs are also due to the necessity of providing comfortable spaces for patients.

- **Safety and security cost:** Costs including access control systems, access patterns in special rooms, security in case of fire, and/or defense against theft. In addition, these include costs for the security, which must to be ensured at all times for legal protection of personnel against third parties, insurance costs, etc. It also includes costs resulting from accidents or errors deriving from incorrect performances or from defects in the structure.

- **Management and maintenance costs:** Management costs related to the costs generated by general services, which includes food, laundry, information technology, drug distribution, warehouse management, sterilization, cleaning, waste disposal, waste management, etc.

E. Social costs

Social cost can be defined as the expense for an entire society resulting from the construction of a new hospital building. Social costs measure the economic impact of building costs on citizens as mobility costs, parking costs, costs linked to waiting times, subtraction of spaces and functions destined for the community, increase of overbuilding, creation of spaces in which the community is not recognized, and so on.

F. Sustainability costs

Cost of all sustainable measures necessary to reduce the negative environmental impact of interventions. This may include the cost of establishing and maintaining sustainability certifications such as LEED, etc. Some fundamental principles can influence the costs in regard to sustainability throughout the Hospital Building Life Cycle:

- Optimize Site Potential;
- Optimize Adjacencies and Circulations;
- Optimize Energy Use;
- Protect and Conserve Water;
- Optimize Building Space and Material Use;
- Enhance Indoor Environmental Quality (IEQ);
- Optimize Operational and Maintenance Practices;
- Optimize consumption monitoring.

G. Opportunity costs

Opportunity costs are defined as “the benefit that could have been gained from an alternative to a projected course of action.” In microeconomic theory, the opportunity cost, also known as “alternative cost,” is the value (not a benefit) of the choice of a best alternative cost while making a decision. A choice needs to be made between several mutually exclusive alternatives; assuming the best choice is made, it is the "cost" incurred by not enjoying the benefit that would have been had by taking the second best available choice. For example, a situation when the decision to build up a new hospital on vacant land of a city is taken. In the same area, a parking lot, a school, or a sports facility could had been build. The opportunity costs of building the hospital is the value of the benefits foregone of the second-best alternative that is not going to materialize.

There is always questioning in regard to the resilience of a building. It is now recognized that the functions in a hospital will continue to evolve over time, and that any new construction will have a finite lifespan. The goal should be to extend the functional use of healthcare facilities as long as possible by allowing them to evolve logically and coherently over time. In recent decades, the concept of flexibility and adaptability has been promoted with the idea that the construction is an external shell inside of which there are possibilities to fully reorganize the internal space to respond to need for evolution. With this concept, the building is designed with modularity and standardized rooms with universal purpose. In addition, space is kept for possible expansions. Technical solutions allow dealing with all utilities and the HVAC (heating, ventilating, and air conditioning).

However, considering the acceleration of transformation of health service delivery and technology evolution in recent years, the question of resilience is at stake in some cases, as it may be more effective to opt for light constructions rather than resilient buildings. There are studies on how to make best decisions, between re-using an existing building or demolishing and building new. In some countries, such decisions are influenced by the heritage of those buildings and the manner in which the specific country handles it. The possibility to have hospital buildings sold for new functions not related healthcare is also an option for heritage buildings, as well as for “common” buildings.

With the emphasis on sustainable development, much more attention must be placed on hospital building components that will later be removed or demolished. This is part of a full life cycle analysis that takes into account costs associated with removing, recycling, or destroying materials from buildings. Although this is not an immediate cost, it should not be underestimated, because regulations increasingly require the owner of facilities to bear the cost for the final destruction of material from their buildings. BIM can provide solid information on demolition costs at an early stage.

The validity of cost predictions is a major challenge for constructions. Predictive costs often vary significantly with final costs (prediction validity). Late decisions taken in a project are recognized to have a greater impact on construction costs than early decisions. For this reason, it is very important to include as many factors as possible during the feasibility and programming stages, and to have a project with very clear descriptions of all the expected functions of the facility. The functional and space programs are excellent tools for this purpose.

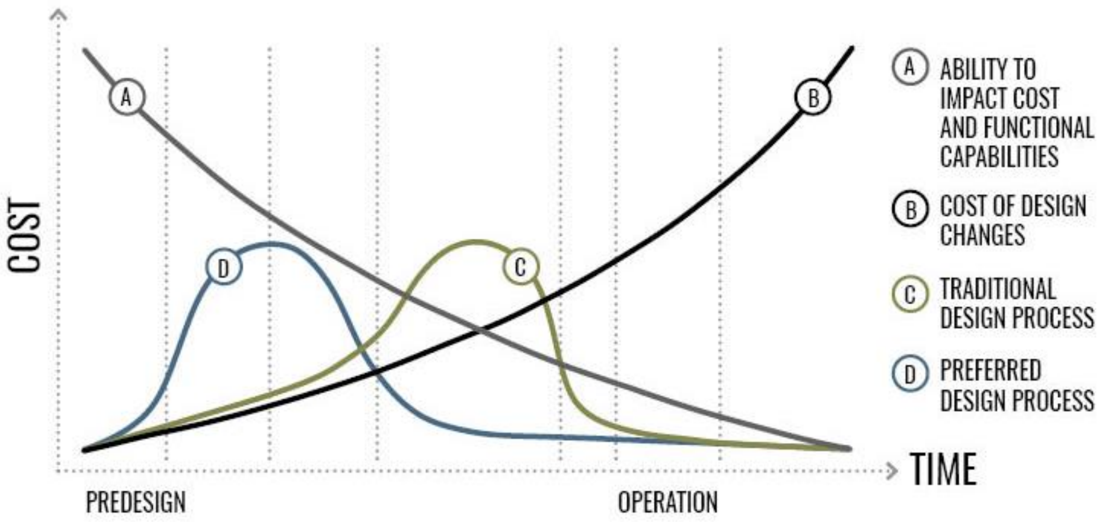


Figure 8: Cost of change over time during project delivery process

It is also important to identify who will bear the cost (the facility, the user, or the community, and determine whether the cost comes at the time of operation or at a earlier stage.

In all projects there is an inherent tension between capital cost and operating costs, as they are usually funded by different mechanisms, and these costs are sometimes borne by different stakeholders. The most effective balance would be to optimize initial capital costs, in order to have the greatest possible impact on reducing functional or operational costs over the life of a facility. This dilemma highlights the importance of making decisions that concern the full life cycle of a building project, as well as the total impact of the operation in the community. There is need to reverse the trend of limited initial investments that lead to expensive operating costs over time. Careful consideration of functionality and commitment by the owner to their decisions is critical in reversing this trend so that the information provided, on which the design is based, will lead to the strongest possible alignment between the building design and functionality.

7. The way forward in cost containment

The general aim must be more about optimizing value and having a grip on cost-benefit of both capital and operational decisions in relationship to one another, rather than just seeking cost containment. Containing costs, reducing waste, and increasing efficiencies are all outcomes of strong alignment between design and functionality. Using a matrix can be helpful in covering all of the domains addressed in the previous discussion, as it can help ensure that the most relevant stakeholders address all cost factors at the appropriate stages of project development.

			BUILDING COSTS						IN USE COSTS									
	PROFESSIONAL COSTS	COST OF PHASING	Post of land	Construction value	Equipment cost	Transformation and adaptive reuse costs	Demolition costs	INFRASTRUCTURE COSTS	Logistics cost	Administration cost	Medical support cost	Patient care cost	Energy cost	Safety and security cost	Management and mainten.	SOCIAL COSTS	SUSTAINABILITY COSTS	OPPORTUNITY COSTS
PRE-PROGRAM.																		
FEASIBILITY STUDY																		
PROJECT PROGRAM																		
DESIGN DEVELOPMENT																		

Figure 9: The matrix

At each step of the process it is necessary to specify any given decision's "cost-conditioning" or life cycle cost-benefit and the relevant decision-makers. This way, it is possible to formulate recommendations on how to reduce costs through design for each type of decision, and for every stage of the project.

At this stage, the identification of roles and responsibilities of the stakeholder(s) is the critical step to understanding how the decision-making process is affecting costs at each step of the project phases:

- **Client:** this is for the entity that owns the hospital and will be in charge of operating it once commissioned. In countries where public hospitals are not autonomous the Ministry of Health is typically the legal entity in charge of the hospital, but different people will be involved during the construction, and subsequent operation, of a project. This is potentially a major source of conflicting priorities because decision makers who initiate and make decisions during the project delivery phases may have limited interest and/or knowledge on the operation of the hospital. In autonomous hospitals, the owner is a governing board or body with a chairman of the board or a chief executive officer who answers to said board.

  In the private sector, a similar situation may occur when there is a private health system or investor that will contract with a management company to operate the hospital. The client may have limited insights on optimizing operation costs or on designing the organizational and operational systems.

- **Design Team:** This is used as a generic term to cover the professionals who will be leading the architecture and engineering required for the project phases. This will also include all of the specified technical contributions included in the project phases. Usually the leadership of the design team is given to an architect, but more and more a team of architects, engineers, and construction contractors operate in mutual and shared leadership position.

- **Construction or Construction Management Companies:** Their role may vary according to the procurement processes. In a traditional project, these entities may only be involved after the design phase is concluded and procurement is initiated. In comprehensive projects, involving various forms of integrated project delivery, these companies may be selected at an early stage and be involved in some capacity during the project program and design development. This approach has not always provided results as expected.

- **Executive staff:** This group represents the decision makers in charge of piloting and running the facility. It can often times be a third-party company when there is a management contract.

- **Hospital staff:** All those that will be involved in delivering healthcare and associated support services. This represents a large variety of professions, and their mobilization is always a complicated task. It is important to involve them in the very specific parts of the hospital related to their specialty. For the overall functions, it will be necessary to have specific mechanism to designate representatives. Legal requirements may influence the type and nature of participants involved in the overall process.

- **Community:** Community representation typically varies by either country specific, or regional/local involvement. This involvement is of key importance in assuring that the voice and needs of the population being served by the development are heard and received throughout the project.

- **Patients**: In a context of increasing chronic conditions, there are an increasing number of patient advocacy organizations. They play an important role for chronic conditions because they represent people who are frequent and recurrent users with a high level of interest in the care process. This is also common for very specific domains where families are involved in the care, such as pediatrics and obstetrical care. It can include specialized associations supporting the hospital, like patient visitor’s association etc.

- **Authorities:** They may be at different levels from the city where the hospital is built, depending on the country. They are responsible for regulating, approving, or assessing projects. In some cases, there could be several authorities involved for different, or similar, matters. Their authority may vary according to national or local regulations.

CONTEXTUAL ELEMENTS Environmental contextual elements Social contextual elements Economic contextual elements Geographic contextual elements Legislative reference framework (local, regional, national; town planning, archaeological, restriction-based regulations.) Healthcare organization model (relationship between the healthcare network and the hospital, the role of the hospital and the use of the hospital) Level of innovation and technological development	PROFESSIONAL COSTS	BUILDING COSTS	INFRASTRUCTURE COSTS	OPERATING OR IN USE COSTS	SOCIAL COSTS	SUSTAINABILITY COSTS	OPPORTUNITY COSTS
DECISIONS IN THE PRE-PROGRAMMING PHASE							
Identification of the community and population or market to be served							
Choice of the location in relation with urban development perspectives							
Dealing with existing facilities owned or possibly purchased							
Definition of the scope and mix of services in relation to health needs and existing offering							
Definition of the type of organization and delivery model							
Choice of the process model for selecting the architect in relation with country regulation							
Choice of modalities for funding the project and operating the facility							
DECISIONS IN THE FEASIBILITY PHASE							
Definition of the all legal and technical requirements or standards							
Definition of the technical feasibility: functional and technology options							
Implementation: climate, geological and site analysis							
Definition of the sustainability objectives (energy and carbon foot print)							
Choice of the business model (costing and financing) including cost benefit analysis							
Choice of the operational model and level of outsourcing							
Definition of the program considerations regarding timeline and activity relocation							
Definition of the project execution plans identifying critical phases							
Definition of the masterplan as recap of the functional and space program							
Definition of the procurement options							

DECISIONS IN THE "PROJECT PROGRAM" PHASE							
Definition of the health organizational model (e.g., departmental structures)							
Definition of the main indicators (beds / surfaces / ...)							
Choice of the articulation of hospital macro-areas or departmental areas.							
Choice of the building characteristics and its lifespan							
Definition of the building surface areas and volume							
Definition of the flow and management aspects							
Estimation of whole project costs							
Estimation of the maintenance of the building and infrastructure							
Definition of the timeline requirements							
Definition of the disable people requirements							
Definition of the phasing of the construction and the financial implications							
DECISIONS IN THE DESIGN DEVELOPMENT PHASE							
Choice of utilities and their implementation							
Choice of the heating ventilating and cooling system							
Choice of the structural characteristics (fire, seismic, foundation)							
Choice of the building elements							
Definition of requirements in relation to equipment and utilization of the surface							
Definition of interior and exterior material for the finishing							
Choice of lightning characteristics							
Definition of contractual requirements for technical prescriptions, timelines and costs							
Definition of furnishing and its implementation in the buildings							
Definition of technical equipment including biomedical devices							
Definition of exterior setting (roads and parking, green zone, etc)							
Choice of signage solutions and implementation							
Definition of the life cycle assessment of all the component for the building (sustainable development)							

C = Client - **D** = Designer - **B** = Building Company - **E** = Executive staff - **H** = Hospital staff - **M** = Community – **P** = Patient – **A** = Authority

Figure 10: Table for phases and cost with the relevant stakeholders for decision-making

8. Next steps

The objective of this white paper is to introduce a program that could be translated into a digital platform for sharing best practices about ways to reduce hospital costs through better design. These best practices will be derived from: analysis of some experiences successfully concluded with a real cost savings; scientific research with tangible output about cost savings; and innovative processes or products that demonstrate a real cost savings and efficiency.

It is important to define the framework for positioning all the "products" to be collected. This framework is an open matrix in which there are, on the vertical axis, the most important phases of the design process that could impact cost savings, and, on the horizontal axis, cost items related to hospital life cycle costs.

This matrix can be used as a roadmap for collecting information on cost reduction through hospital design. It will be possible to move through it, filling in information for each box of the matrix by following the same list of questions as a critical path:

- Identify key stakeholders and all informed parties to be involved in decision making;
- Differentiate general interest and short-term interest for each of the various stakeholders;
- Identify bodies of knowledge that are available;
- Differentiate information with regards to stakeholder (initial, basic, advanced and specialized knowledge);
- Provide a big-picture approach encompassing all factors, showcasing as many examples as possible;
- Put forward best practices stemming from reported experiences;
- Expected outcomes are recommendations which can be customized to contextual factors.

9. Appendix

Annex 1 – List of participants (by order of country)

Luciano Monza, Architect
Asociación Argentina de Arquitectura e Ingeniería Hospitalaria – AADAIH
Argentina

Warren Kerr AM, Architect
Adjunct Professor, University of Western Australia
National Director, Health Portfolio, Hames Sharley Architects and Planners
Australia

Kate Copeland, Chair
Australian Health Design Council
Australia

Jean Stoefs, Director of Saint Luc 2025 Project
CHU Louvain
Belgium

Fabio Bitencourt, Architect
IFHE - International Federation of Hospital Engineering - Executive Committée
Brazil

Jorge Castro, Professor
Universidade Federal Fluminense
Brazil

Clifford Harvey, Architect
Director (2017-2020)
International Union of Architects - Public Health Group
Canada

Martin Fiset, Architect
Responsible for the architectural competition for students
Union of Architects - Public Health Group
Canada

Thomas Schinko, Associate Architect
Vasconi
France

Henning Lensch, Managing Director
RRP International Hospital Planners Ptd. Ltd.
Singapore / Germany

Nirit Pilosof, Architect & Ph.D. candidate
Faculty of Architecture and Town Planning
Technion – Israel Institute of Technology
Israel

Romano del Nord, Architect and Professor
TESIS
Italy

Roberto Bologna, Professor
University of Florence
Italy

Sandra Carlini, Architect
TESIS
Italy

Maria Grazia Giardinelli, PhD, Architect
TESIS
Italy

Luca Marzi, PhD, Professor
University of Florence
Italy

Norwina Mohd Nawawi, Associate Professor
Department of Architecture, Kulliyyah of Architecture and Environmental Design
Malaysia

Giuseppe Lacanna, Architect
TU Delft – Head of UIA-PHG Young Leaders Group
Netherlands

Knut Bergsland, Executive Member
Union of Architects - Public Health Group
Norway

Johan van der Zwart, Postdoc Architecture & Health
Norwegian University of Science & Technology (NTNU)
Norway

Samir Sadruddin, Head of Design
Aga Khan University
Pakistan

Prosperidad Luis, Executive Member
Union of Architects - Public Health Group
Philippines

Rufi Macagba, Chairman and CEO
Lorma Medical Center
Philippines

Pedro Cabral, Architect
Administração Central do Sistema de Saúde, IP
Ministry of Health
Portugal

Sofia Coutinho, Head of Facilities and Equipment Unit – UIE
Administração Central do Sistema de Saúde, IP
Ministry of Health
Portugal

Ruzica Bozovic-Stamenovic, Associate Professor
NUS National University of Singapore, SDE School of Design and Environment, Department of Architecture
Singapore

Peta de Jager, Research group leader
Architectural Engineering - Building Science and Technology - Built Environment – CSIR
South Africa

Carme Padullés Garcia, CFO
Hospital General de Granollers
Spain

Jordi Aragón Donaire, Cap d'Infraestructures i Manteniment
Fundació Privada Hospital Asil de Granollers
Spain

Hans Eggen, Executive Member and Past President
Union of Architects - Public Health Group
Switzerland

Eric de Roodenbeke, CEO
International Hospital Federation
Switzerland

Patricia C. Williams, MS, FACHE, Founder and President
Global Health Services Network
USA

David Allison FAIA, FACHA Alumni Distinguished Professor and Director
Graduate Studies in Architecture + Health, Clemson University
USA

Philip Patrick Sun AIA, ACHA, NCARB
ACMHS
USA

Chad Beebe, Deputy Executive Director
American Society for Healthcare Engineering / AHA
USA

Annex 2 – Template for information collection

The following is a template for the collection of products from experts involved in successful experiences that demonstrate a cost reduction during the design phases of a hospital development:

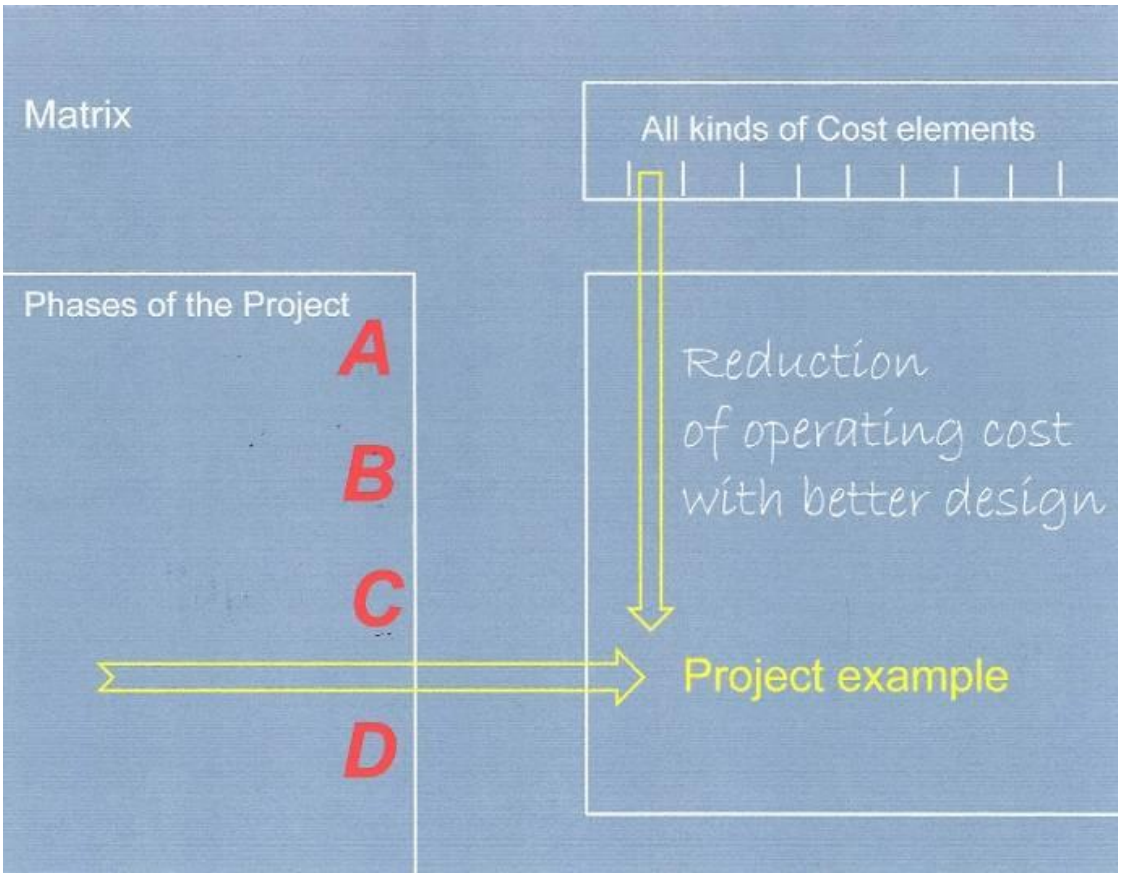
1.1.	**Subject/title of the product**	
1.2.	**Reasons for which the proposed product is considered useful to collecting information on cost containment**	… …. …. ….
1.3.	**Brief description of the proposed product highlighting the actions for the costs containment**	… …. …. ….
1.4.	**Reference to the possible cost items in the product that are subject of cost containment**	… …. …. ….

Annex 3 – Example of decision making for renovation versus construction

Renovation versus new construction

Hans Eggen, Executive member and Former Director of the UIA Architects Work programme Public Health

1. Introduction



(slide 1) Each example can only show a few aspects but can be allocated on an overall matrix.

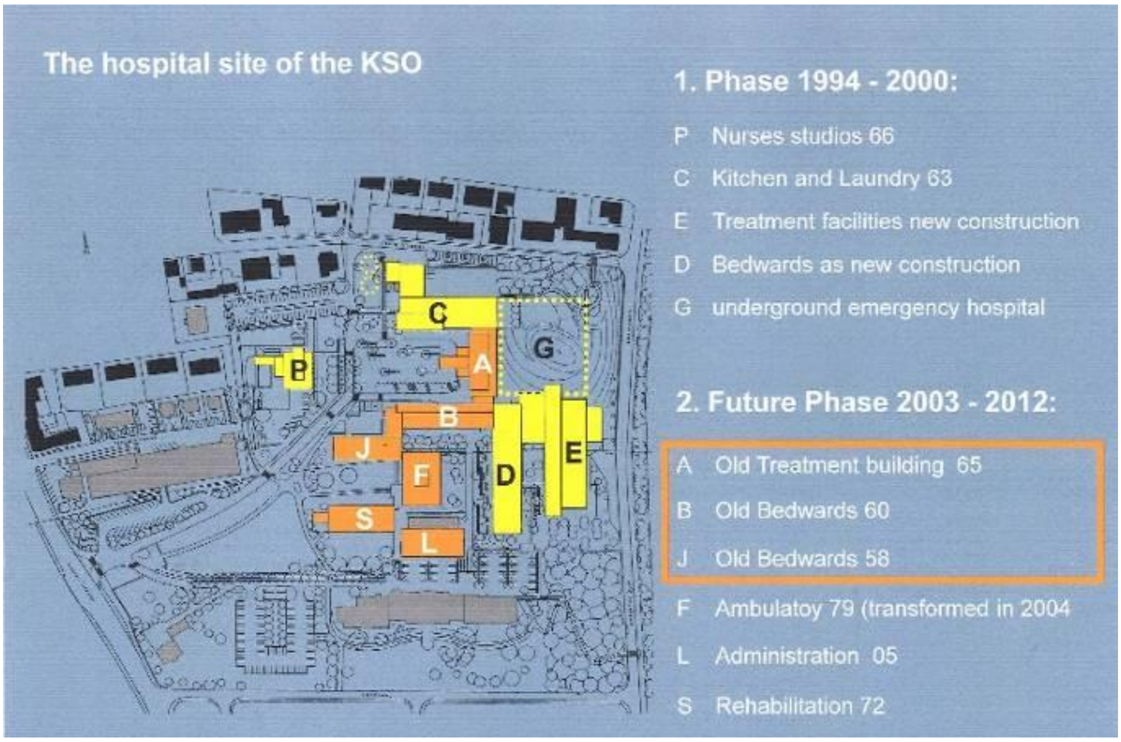
2. Example of Renovation versus new construction

This is the Matrix in detail as it was developed up to this moment.

TECHNICAL AND DESIGN DECISIONAL AREAS		FORMAL DECISIONAL PRODUCTS	OBJECT OF POSSIBLE COST CONTAINMENT											
				BUILDING COSTS					IN USE COSTS					
			TECHNICAL COSTS	Cost of land	Constr. value	Transform. and adap.	Demolition	INFRASTRUCT. COSTS	Cost of staff	Energy costs	Safety/Sec.	Manag/Maint.	Disposal COSTS	[illegible]
			1.1	2.1	2.2	2.3	2.4	3.1	4.1	4.2	4.3	4.4	5.1	6
PRE-PROGRAMMING Stakeholder and decision makers: Client, Management body, Hospital staff, Community ...	A	Programming acts, laws, standard, rules, guidelines etc.	A 1.1	A 2				A 3.1	A 4				A 5.1	6
FEASIBILITY STUDY Stakeholder and decision makers: Client, Management body, Hospital staff ...	B	Feasibility study report etc.	B 1.1	B 2.1	B 2.2	B 2.3	B 2.4	B 3.1	B 4.1	B 4.2	B 4.3	B 4.4	B 5.1	[illegible]
PROJECT PROGRAM Stakeholder and decision makers: Client, Management body, Hospital staff ...	C	Project documentation project tendering documents etc.						C 3.1	C 4.1		C 4.3	C 4.4	C 5.1	[illegible]
PROJECT Stakeholder and decision makers: Client, Designer, Construction company ...	D	Project solution documents etc.						D 3.1	D 4.1		D 4.3	D 4.4	D 5.1	[illegible]
CONSTRUCTION Stakeholder and decision makers:	[illegible]	Contracts, tender												

(slide 2) As a practical example for cost containment I have chosen an actual case where the decisions have been based practically only on cost evaluations and where the positive and final end result is now visible.

What happened during the previous phase?



(slide 3) After a phase of new buildings added to an existing hospital realised in 2003 (the yellow ones) the remaining buildings should just be renovated (here shown in orange). Let's start with my new argumentation precisely at this moment and concentrate on volumes A, B and J.

(slide 4) On this aerial view, buildings: A B and J, which should be renovated first.

Furthermore, we had an overall cost frame of 250 million CHF including the recently added new buildings, excluding a very old one. We were at this moment confident that we can maintain this original overall budget stipulated in 1994.I will now start my argumentation with the old Building A - the old treatment building out of the year 1965. Please note, that here was up to that moment still the main entrance into the hospital complex and in my opinion the entrance was completely hidden and in a remote corner of the site.

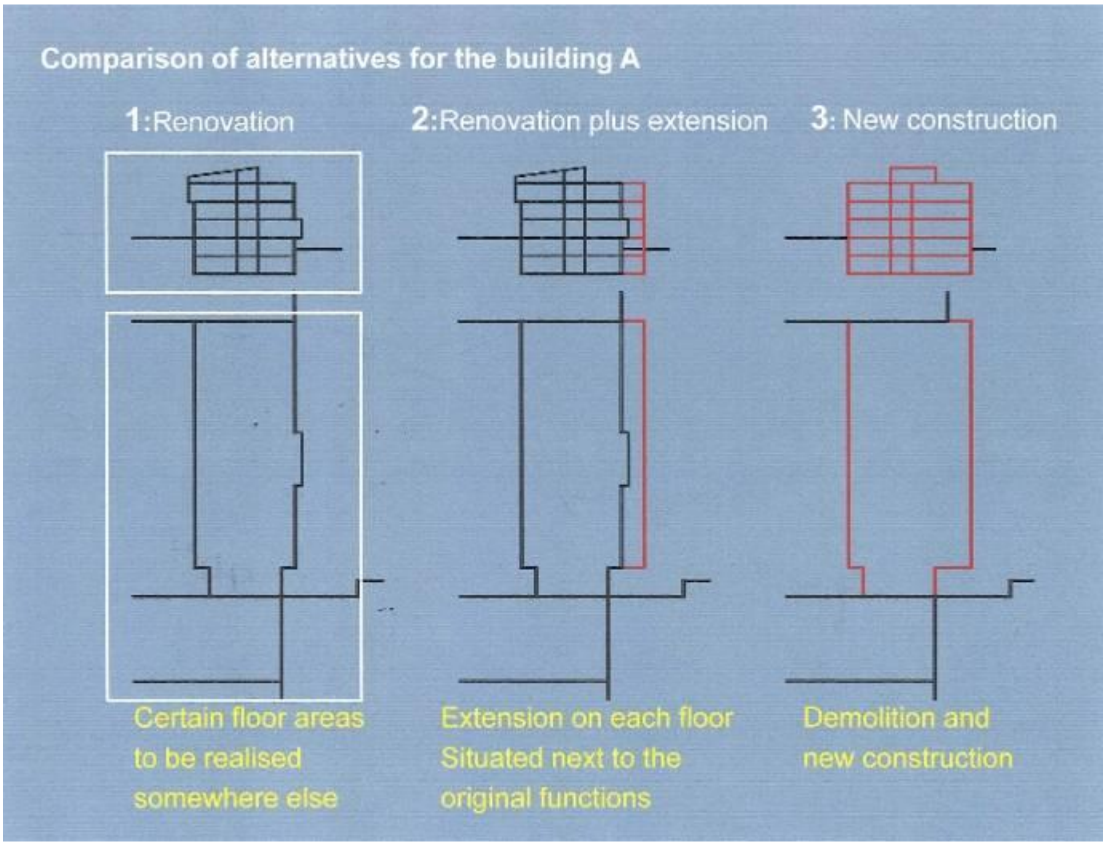
3. Argumentation

When you are just about to renovate an existing old building you will find out that precisely in this moment NEW REQUIREMENTS will come up. First of all new requirements concerning the standards, asking for better and better thermal insulation. Secondly all hospital buildings have to comply with new standards for earthquake resistance and this becomes valid with the planning of a simple renovation especially also of an old structure. Last but not least are new room requirements:

- A bigger emergency department.
- More laboratory services.
- More medical services here and there.
- More offices.
- More ...

But how would it be possible to integrate all these requirements within the existing volume?

4. Comparison of alternatives



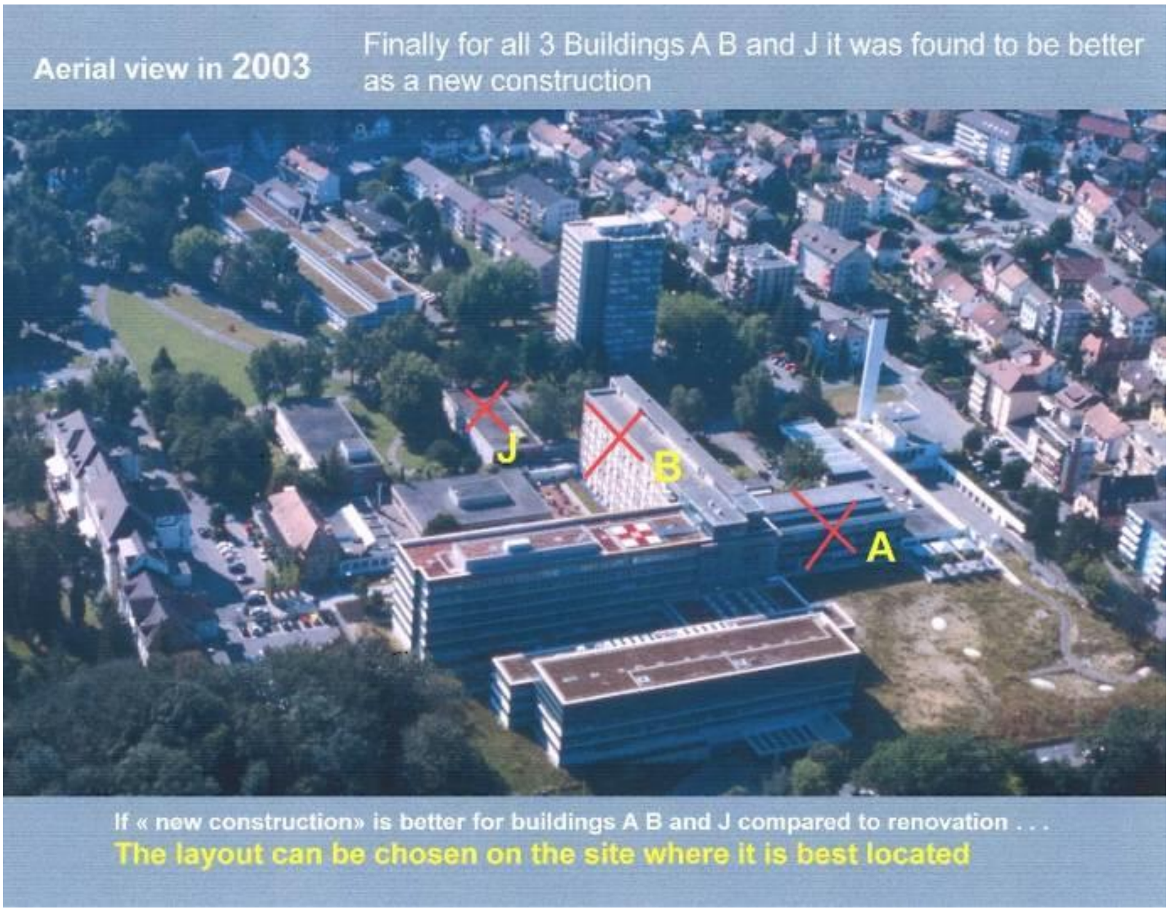
(slide 5) Three different and detailed projects were elaborated and the relative cost have became an important argument. The alternatives are simplified as follows:

Number 1 The simple renovation with extra rooms somewhere else.
Number 2 The renovation with a new additional layer for the extra rooms and
Number 3 A completely new structure with the best layout and flexibility.
Let's jump to the decision: The number 3, the new construction is the most economic.

5. Decision based on cost evaluations

At this moment the decision between the 3 alternatives have been guided by the cost implication, but the projects behind each one have been looked at with the client very carefully. From these detailed comparisons the advantages and of course the disadvantages of each alternative have been discussed at length but operational cost have not been quantified at the beginning.

It is clear, that we made the same procedure for building B and building J and found each time practically the same result except for building J where only the extra operating cost of 190'000 CHF per year brought the decision, that it can be replaced also.



(slide 6) This result is not yet the end of the story. If « new construction» is better for this hospital project, compared with a simple renovation for buildings A B and J, the layout for the total remaining room programme can be chosen on the site where it is best located.

(slide 7) This is the final result (in 2014). The programme for volume A has been placed in the centre of the site, forming also the new entrance to the hospital complex. The programme for the bed wards in volume B have been placed in continuation with the other new bed wards and the volume J disappeared, and placed in form of an additional floor on top of the volume B.

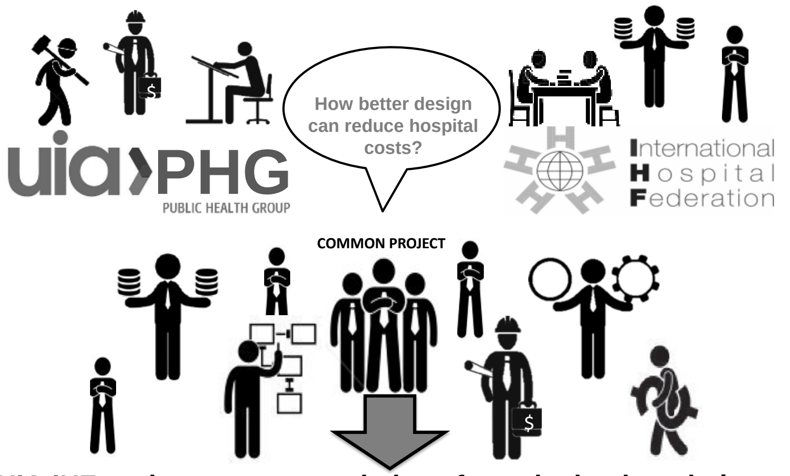
(slide 8) When you enter the site (from the bottom left), the entrance and the two bed ward wings are visible on both the sides in a classical form. The completely new treatment building is standing behind. All this is taking into consideration all the upcoming new requirements for the room programme, the structural requirements in case of earth quakes and the regulations on energy saving and this by maintaining the overall budget of 250 million CHF over a period of more than 20 years.

6. Summary

Starting with the intention just to renovate the remaining old buildings we managed finally to create a completely new hospital with an easily understandable new entrance in the centre.

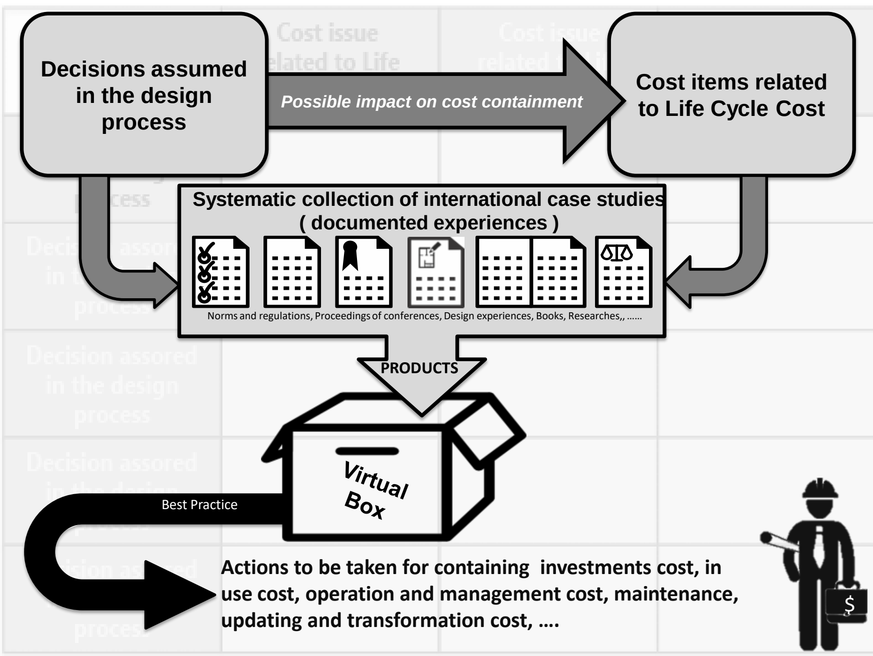
Annex 4 – Further developments

The project work: Definition of issues related to costs containment

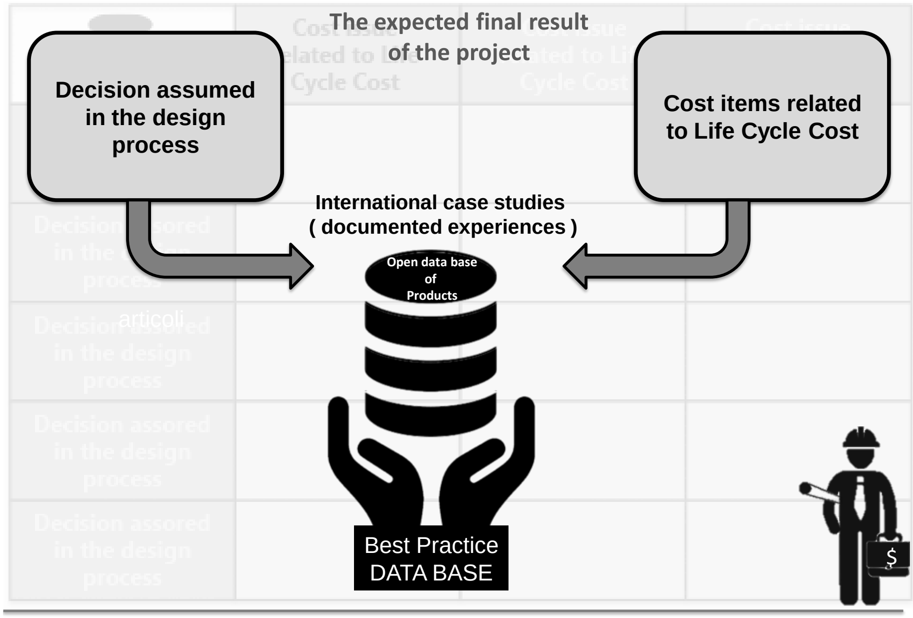


UIA-IHF project: recommendations for reducing hospital cost through better design

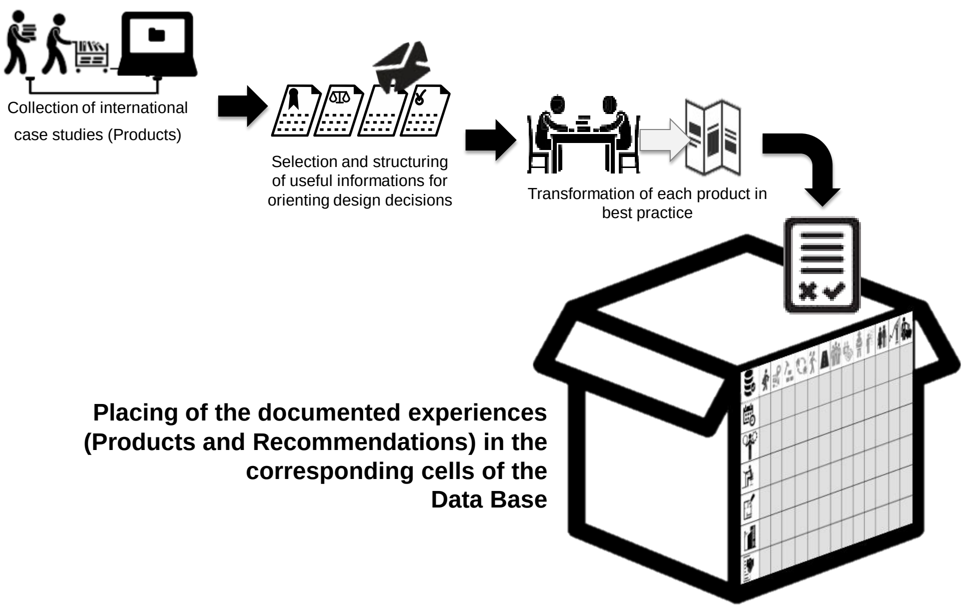
The project work: Definition of the methodology



The project work: Definition of the methodology

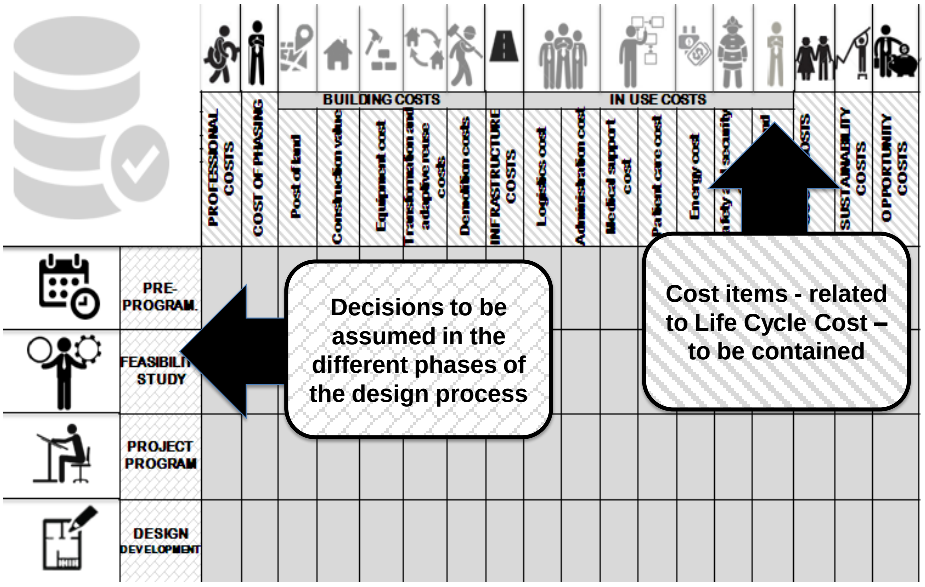


The project work: The phases of the project program

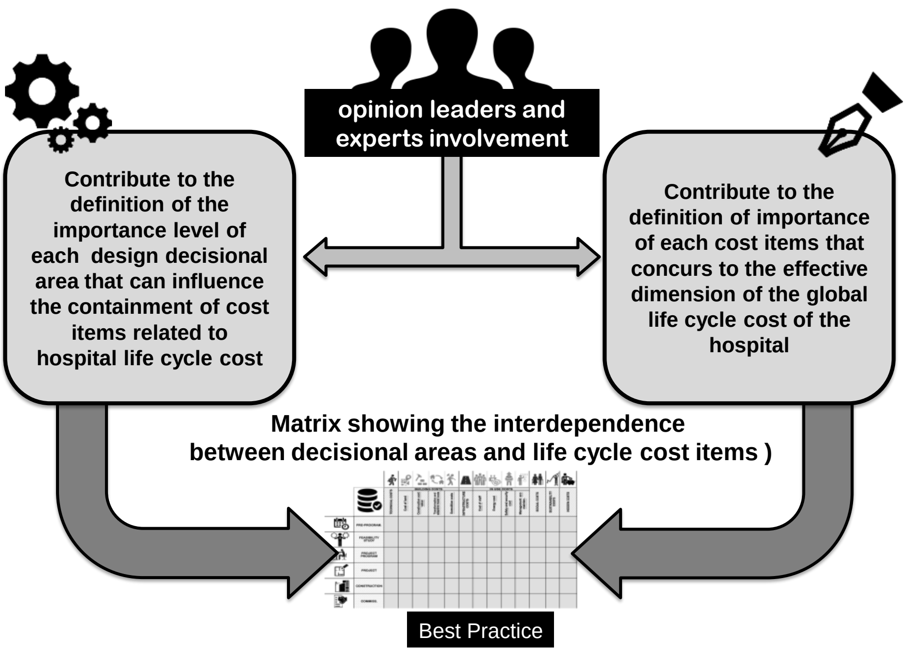


The project work: The framework

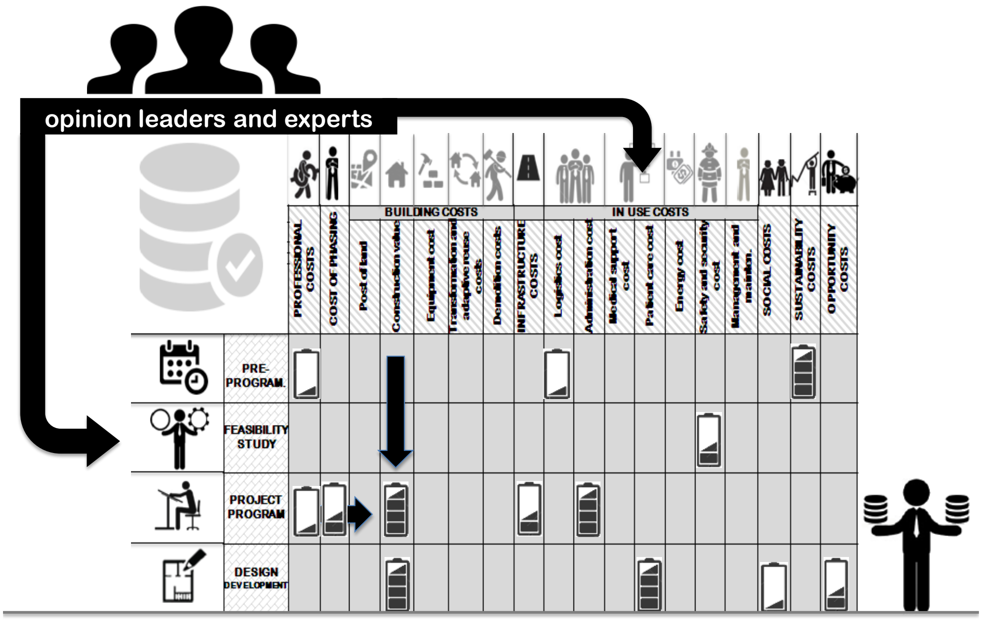
The framework for positioning all the "products" (case studies)
in order to facilitate the consultation



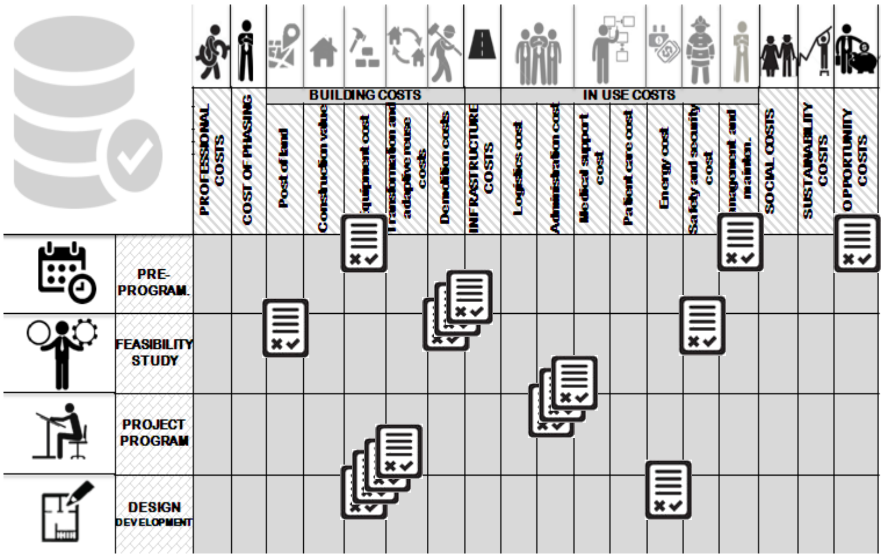
The project work: Opinion leaders and experts involvement



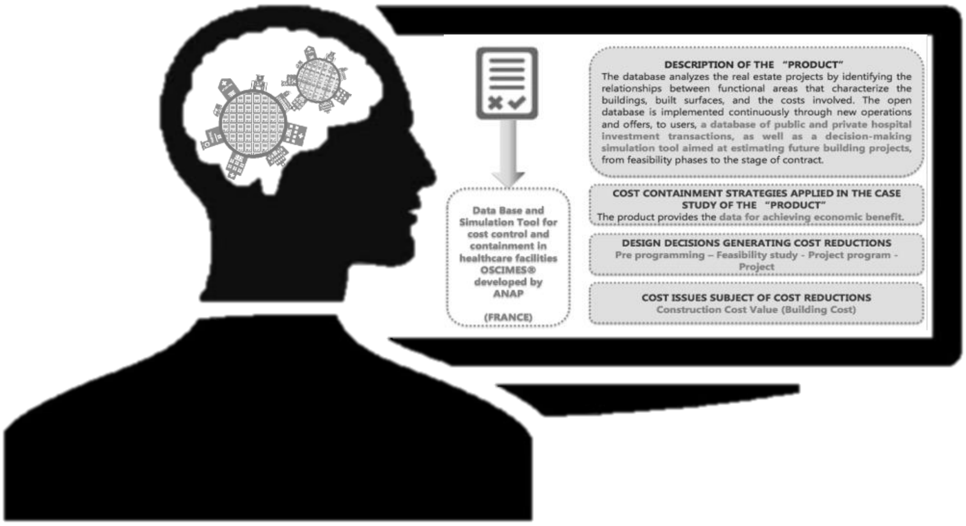
The project work: **Definition of the priority importance of each cost items and each decisional area**



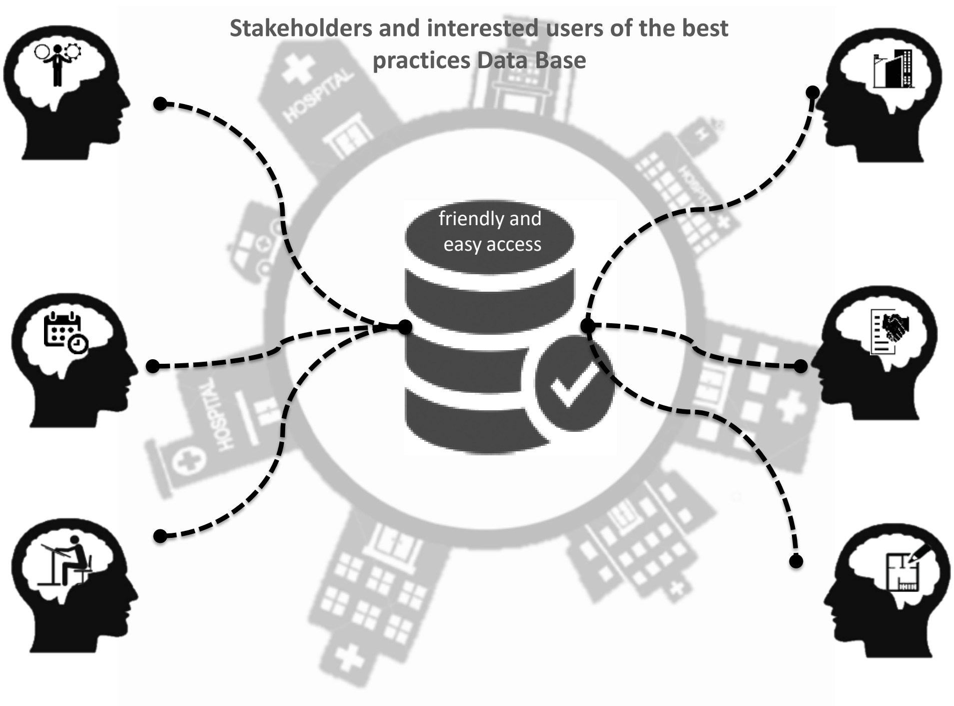
The project work: **Positioning of case studies in the cells of the matrix**



Best Practice quick consultation



Stakeholders and interested users of the best practices Data Base



10. Bibliography

ANAP (Agence National d'Appui à la Performance des établissements de santé et médico-sociaux), *Observatoire des coûts de la construction dans le secteur médico-social. Traitement statistiques*, 2012, https://www.cnsa.fr/documentation/20120531_guide_observatoire.pdf

Bartolucci P., Benmansour El Hadi, Cambon E., Marchal F., Medelli J-F., Richard J-C., (membres de la commission ingénierie et architecture de la conférence des directeurs généraux de CHU), *L'évaluation des coûts d'exploitation maintenance en CHU. Un outil au service de la stratégie patrimoniale des établissements,* Techniques-hospitalieres.fr, http://www.techniques-hospitalieres.fr/article/1058-levaluation-des-couts-dexploitation-maintenance-en-chu-un-outil-au-service-de-la-strategie-patrimoniale-des-etablissements.html, 2014

Belcastro F., Di Santo D., Fasano G., *Indici di benchmark di consumo per diverse tipologie di edificio e all'applicabilità di tecnologie innovative nei diversi climi italiani negli edifici ospedalieri*, ENEA (Agenzia Nazionale per le Nuove Tecnologie e lo Sviluppo Economico Sostenibile), Ministero dello Sviluppo Economico, 2010

Del Nord R., *Cultural issues on the complexity of hospital design*. In: R. Del Nord (a cura di). *Hospital Planning and Building. New ideas in hospital planning and building flexibility, quality and energy efficiency*. p. 9-16, Firenze: TESIS, University of Florence, 2013

Del Nord R., *Rinnovare i modelli di processo con la progettazione digitale multidisciplinare: la sfida lanciata da ADITAZZ nel concorso internazionale "Small Hospital – Big Ideas" - Renewing the models of process through digital design: the challenge launched by ADITAZZ with the "Small Hospital – Big Ideas" International competition*. In: *TECHNE*, vol. 6/2013, p. 22-27

Energy Star, *Score for Hospitals (General Medical and Surgical)*, 2011 - http://meaenergysavingbuilding.net/downloads/energy%20star_technical%20methodology%20for%20hospital.pdf

Giancotti M., Guglielmo A., Mauro M., *Efficiency and optimal size of hospitals: Results of a systematic search* PLOS Published: March 29, 2017, https://doi.org/10.1371/journal.pone.0174533

Giovenale A. M., *Il progetto preliminare nell'edilizia ospedaliera*, Edizioni Kappa, Roma, 1998

Green@Hospital project, *Web-based Energy Management System for optimization of the Energy Consumption in Hospitals* (project coordinator: Cristina Cristalli), 2012-2015, http://www.greenhospital-project.eu/wp-content/uploads/2015/08/Green@Hospital-Final-report.pdf

International Facility Management Association, *Operations and Maintenance Benchmarks for Health Care Facilities Report,* 2010

International Labour Organisation, *Thailand: Universal Health Care Coverage Through Pluralistic Approaches* - http://www.ilo.org/wcmsp5/groups/public/---ed_protect/---soc_sec/documents/publication/wcms_secsoc_6612.pdf

Joint Commission Resources, *Planning, Design and Construction of Health Care Facilities*, The American Institute of Architects – Academy of Architecture for Health, 2015

Lavy Sarel, Shohet Igal M., *A strategic integrated healthcare facility management model*. In : *International Journal of Strategic Property Management*, 11, 125-142, 2007

Life-enviroment "Emas and Information Technology in Hospitals" LIFE04 ENV/GR/000114, *Guidelines for Energy Efficiency in Hospitals*, EPTA Environmental Engineers-Consultants, 2007, http://ec.europa.eu/environment/life/project/Projects/files/book/LIFE04ENVGR114-EE.pdf

Madritsch T., Steixner D., Ostermann H., Staudinger R., *Operating cost analyses of long-term care facilities*. In: *Journal of Facilities Management*, Vol. 6 No. 2, 2008

Madritsch T., *Best practice benchmarking in order to analyze operating costs in the health care sector.* In: *Journal of Facilities Management*, Vol. 7 No. 1, 2009

Mutti A., Provenzano D., *DPP. Sanità. Guida per la redazione del documento preliminare alla progettazione*, Edizioni Kappa, Roma, 2003

NHS Sustainable Development Unit (SDU). *Sustainable, resilient, healthy people & places. a sustainable development strategy for the NHS, public health and social care system*. Report, 2014, http://www.sduhealth.org.uk/policy-strategy/engagement-resources.aspx

OECD, Health at a Glance 2017: OECD Indicators, OECD Publishing, Paris, 2017 https://doi.org/10.1787/health_glance-2017-en

Sadatsafavi H., Shepley M. M., *Performance evaluation of 32 LEED hospitals on operation costs, International Conference on Sustainable Design, Engineering and Construction. In: Procedia Engineering* 145, 2016, 1234 – 1241

Santamouris M., Dascalaki E., Balaras C., Argiriou A., Gaglia A. *Energy performance and energy conservation in health care buildings in Hellas*. In: *Energy Conversion and Management*, 1994.

Shohet Igal M., *Key performance indicators for maintenance of health‐care facilities*. In: *Facilities*, Vol. 21 Issue: 1/2, pp.5-12, 2003, https://doi.org/10.1108/02632770310460496 Igal M. Shohet

Sliteen S., Boussabaine H., Catarina O., *Benchmarking operation and maintenance costs of French healthcare facilities.* In: *Journal of Facilities Management*, Vol. 9 No. 4, 2011

Støre-Valen M., Larssen A. K., Bjørberg S., *Buildings' impact on effective hospital services: The means of the property management role in Norwegian hospitals*. In: *Journal of Health Organization and Management*, Vol. 28 Iss 3, 2014, pp. 386 – 404, https://doi.org/10.1108/JHOM-08-2012-0150

Talib Y., Jing Yang R., Rajagopalan P., *Evaluation of building performance for strategic facilities management in healthcare: A case study of a public hospital in Australia*. In: *Facilities*, Vol. 31 Issue: 13/14, 2013, pp.681-701, https://doi.org/10.1108/f-06-2012-0042

The Center for Health Design, *A Guide to Clinic Design Post-Occupancy Evaluation Toolkit,* https://www.healthdesign.org/, 2014-2015

UHC 2030 International Health Partnership, *Healthy systems for universal health coverage - a joint vision for healthy lives* - https://www.uhc2030.org/our-mission/joint-vision/

Western Michigan University, *About the University Planning and Construction Process*, http://www.cf.wmich.edu/campusfacilities/Process/index.htm

Whitson *A., Developing a Plan for Reducing Energy Costs in Hospitals.* In*: Healthcare Cost Containment*, 2012

World Health Organisation (WHO), *Declaration of Astana on Primary Health Care*, October 2018 - https://www.who.int/docs/default-source/primary-health/declaration/gcphc-declaration.pdf

World Health Organisation (WHO), *Global strategy on human resources for health: Workforce 2030, 2016* – http://apps.who.int/iris/bitstream/handle/10665/250368/9789241511131-eng.pdf?sequence=1

World Health Organisation (WHO), The *World Health Report 2010. Health Systems Financing. The Path to Universal Coverage*, 2010 - https://www.who.int/whr/2010/10_summary_en.pdf