A Guide on Aligning Infrastructure Decisions with Healthcare Business Plans

FITZEMEYER & TOCCI ASSOCIATES, INC.

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Aligning Infrastructure Decisions with Healthcare Business Plans Guide

Published by Fitzemeyer & Tocci Associates, Inc.
300 Unicorn Park Drive, 5th Floor
Woburn, MA 01801

Design by Fitzemeyer & Tocci Associates, Inc.
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About this Guide

To effectively control and optimize capital spending on Healthcare facility infrastructure systems, there must be a sound and direct link between the goals of any infrastructure expenditure and the business plan of the facility and its proposed Healthcare services. Misalignment between these two can result in overspending, overbuilding, and ultimately reduction in capital for other, potentially higher return, investments. Adding to the difficulty of the situation, is the increasing need for nimble infrastructure systems that can react to changes in technology, reimbursement models, and other market pressures. This guide will provide recommendations, advice, and case studies to help Healthcare leaders navigate infrastructure decision making and ultimately align capital spending with facility service goals.

Learning Objectives

-Be able to define the process components necessary for alignment between business models and infrastructure decision.

-Identify the important components of a facility business model that are part of the facility's overall success.

-Be able to complete a gap analysis to analyze the consistency of infrastructure decisions vs. a facility business model.

-Be able to construct a successful integration model that optimizes infrastructure decisions with a facility business model.

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As Principal, Scott serves as the overall supervisor of the project management teams, being actively involved in the design and management of all projects within the firm, with particular experience working with healthcare clients. In his role as Principal, Scott directs, leads and ensures the incorporation of all client requirements, reviews all project deliverables and coordinates and monitors all design and construction activities. He has devoted his energy to leading multi-disciplined engineering groups within the firm. His primary goal is to consistently meet all client expectations by delivering successful and innovative solutions.

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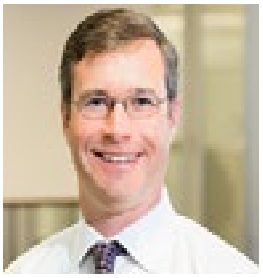

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BACKGROUND

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1 BACKGROUND

Basis for Infrastructure Spending Optimization

In a recent Healthcare Advisory Board publication, the organization researched top insights hospital chief executive officers could leverage to more effectively compete in the contemporary, consumer-driven, healthcare market.[1] One of the twelve major "insights" focused on the need for "radical" transformation of fixed costs…one of these being the cost of facility infrastructure. To effectively control and optimize capital spending on Healthcare facility infrastructure systems, there must be a sound and direct link between the goals of any infrastructure expenditure and the business plan of the facility and its proposed Healthcare services. Misalignment between these can result in overspending, overbuilding, and ultimately reduction in capital for other, potentially higher return, investments. Adding to the difficulty of the situation is the increasing need for nimble infrastructure systems that can react to changes in technology, reimbursement models, and other market pressures. This guide will provide recommendations, advice, and case studies that help Healthcare leaders navigate infrastructure decision making and ultimately align capital spending with facility service goals.

Infrastructure Value and Costs

With the understanding that infrastructure spending must be transformed, the first thing to get a handle on is how many dollars are we typically talking about and where do they go…i.e. for a typical Healthcare organization, how much of their capital ends up supporting the building, operating, and maintaining of facilities. To answer this, several healthcare organizations have been surveyed for member feedback and data. The results of surveys show overall hospital "facility infrastructure" related spending to be in the range of 10-15 percent of total health network expenditures. Studies also show that hospital capital budgets themselves are made up of approximately 15% infrastructure related money. [2]

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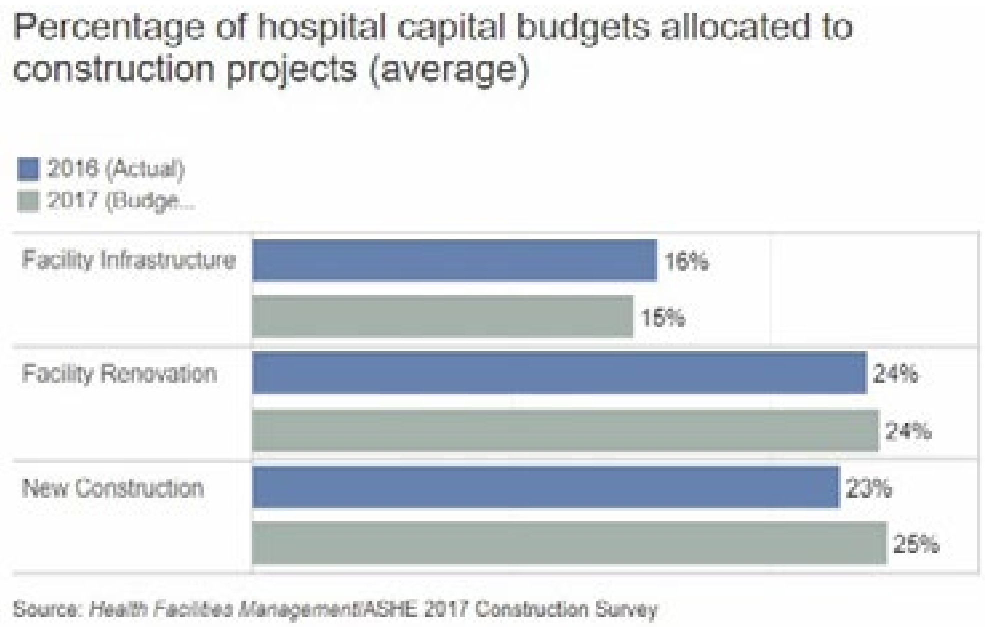

One such study by Premier Inc., surveyed approximately 3,750 hospitals and healthcare provider organizations across the country. The results of the Premier study indicate most hospital's top three capital investments are for health information technology (72.2 percent of respondents), facility construction/renovation (51.9 percent of respondents), and new imaging equipment (44.4 percent of respondents).[3] Breaking down the facility construction related capital spending further the Health Facilities Management magazine, ASHE 2017 Construction Survey, shows that hospitals spend on average approximately 16% of their capital budgets on equipment replacement/upgrade, 24% of their budgets on facility renovations, and 25% of their budgets on facility new construction.[4]

"Most hospital's top three capital investments are for health information technology, facility construction/renovation, and new imaging equipment"[3]

Benefits and Costs of Alignment

Aligning the business model with the healthcare facility infrastructure system is extremely beneficial. By aligning a infrastructure system design with a business model, you can effectively control and optimize the capital spending on the infrastructure systems to compound the effectiveness of the business model. Aligned infrastructure decisions also help mitigate situations where the final construction is over built or ill-fitting for the use of the facility. There are so many options when it comes to healthcare facility infrastructure systems it's important that these be tailored to match needs. If the business model and the infrastructure systems are not aligned the facility can also become a financial failure due to excessive operating costs or high initial capital expenditures that aren't necessary for the type of business that is being operated.

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THE PROCESS OF GETTING ALIGNED

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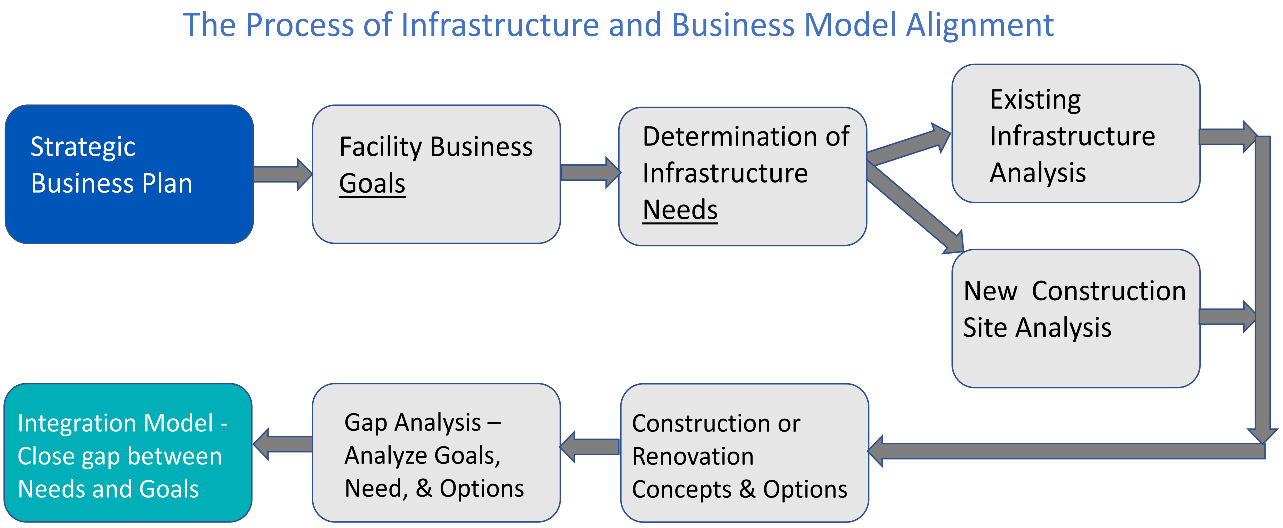
2 The Process of Getting Aligned



Understanding the Facility Business Model

To start the overall process of ensuring infrastructure decisions (design, construction, replacement, etc.) are aligned with the actual facility business model the first step is to actually get a thorough understanding of what the business model is, including goals and economic inputs.

At an initial level, the first component of a facility business model is the proposed initial capital spending budget itself, including both construction/renovation costs, design and engineering fees, and all other owner furniture, fixture, and equipment costs (soft costs). A clear understanding of the overall project costs is a baseline information requirement for alignment of design level infrastructure decision making efforts.

The next component of the facility business model is the anticipated (or goal) operational cost for the facility; specifically, with regard to aspects such as maintenance supplies, full-time-equivalent operators, and energy/utility budgets. The decisions made during a design process can have significant impact on operational costs, and thus careful optimization of first costs (capital costs) and operational cost needs to be discussed, understood by all building team members, and incorporated into the overall strategy of infrastructure decision making. As an example of the level of impact operational costs can have, all-in utility costs for a typical outpatient clinic facility in the northeast sector of the US could easily vary anywhere between $2-$4/sf annually, depending on the infrastructure systems incorporated. Looking at this over a 20-year lifespan for a 50,000 SF outpatient building could mean the difference between a 20-year operation cost of $2 million or $4 million. It's highly likely the extra $2 million worth of utility costs could have been better spent in efforts towards improving the program effectiveness of the facility and overall goals of the business model.

Percentile	Total Utilities ($/GSF)	Electricity ($/GSF)	Fuel Oil #2 ($/GSF)	Natural Gas ($/GSF)	Steam ($/GSF)	Water ($/GSF)	Sewer ($/GSF)
99	$11.97	$6.34	-----	$4.33	-----	$0.71	-----
95	$10.81	$5.23	$0.93	$2.46	-----	$0.54	$0.42
90	$7.56	$4.65	$0.44	$1.98	$3.36	$0.49	$0.35
75	$5.82	$3.35	$0.11	$1.58	$2.08	$0.35	$0.23
50	$4.06	$2.22	$0.03	$1.15	$0.74	$0.23	$0.16
25	$3.01	$1.50	$0.02	$0.69	$0.07	$0.13	$0.10
10	$2.14	$1.05	$0.005	$0.14	$0.002	$0.06	$0.03
5	$1.59	$0.73	$0.001	$0.06	-----	$0.04	$0.004
1	$0.31	$0.27	----	$0.01	-----	$0.02	-----
Mean	$4.61	$2.49	$0.12	$1.18	$1.22	$0.25	$0.18
N=	130	129	52	134	13	130	63

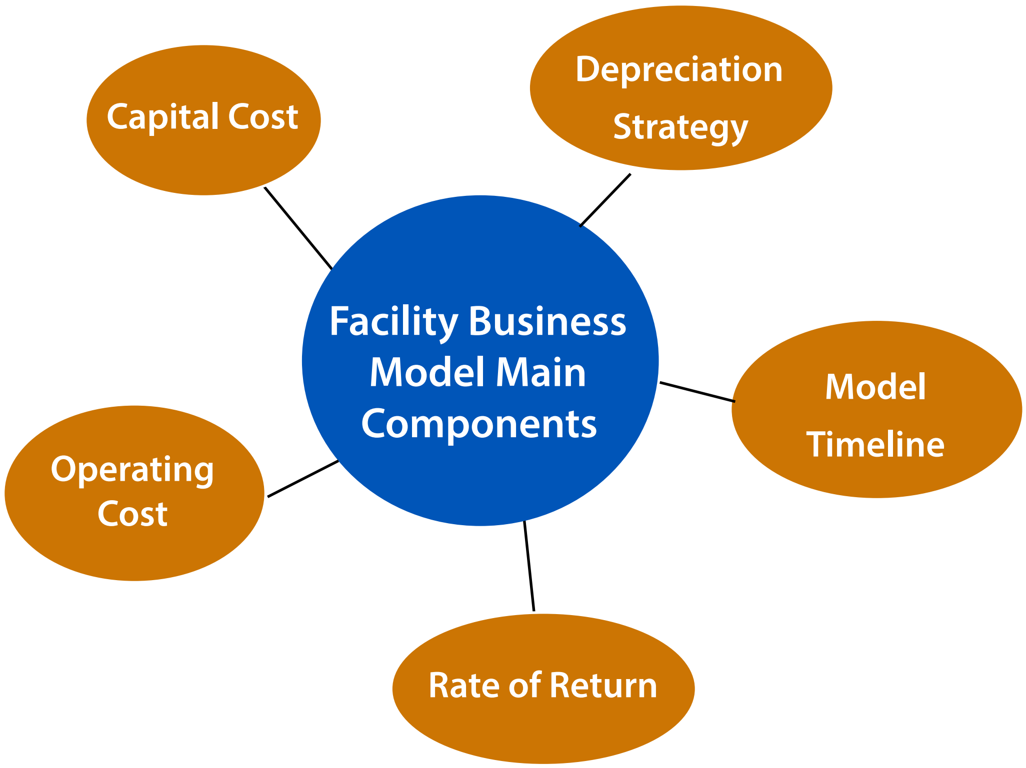
Best In Class

Operations and Maintenance Benchmarks for Health Care Facilities Report © IFMA 2010

When making infrastructure decisions for any capital expenditure it is also important to also understand the savings-to-investment ratio an infrastructure decision can produce and make sure its aligned with the analysis that was done as part of the overall facility business model. The savings-to-investment ratio (SIR) predicts the savings/return an infrastructure decision can provide as compared against the healthcare organization's internal discount rate (i.e. the "mandated" investment return internally). In particular, the discount rate used for an infrastructure decisions life cycle analysis must be the same as that used in the overall facility business model's economic analysis. Put another way, if the overall facility business model incorporates a minimum of 5% return on investment for the new facility and its services, an infrastructure decision's payback needs to exceed 5% before its even really a "break even" decision.

The next step in fully understanding a facility business model is to accurately assess the timeline of the model. The economics of the intended healthcare services (for the new or renovated facility) typically include an anticipated ownership/lease/etc. duration where the healthcare organization anticipates returning their capital investment and continue to produce operating revenue. When evaluating various infrastructure decisions or options, the evaluation period for payback on any particular infrastructure option needs to be securely within the facility business model timeline. A good example of this concept can be seen when evaluating infrastructure decisions for an urgent care type facility. It's not uncommon for the business model of an urgent care facility to need positive return on investment within 3-5 years of construction. When designing this type of facility, the evaluation of infrastructure options will therefore need to provide return in the same short time frame; deciding to implement an infrastructure option that requires something like 10 years to show positive savings-to-investment ratio may never materialize in the time the organization operates the facility.

One last thing to consider when understanding a facility business model is the effect of depreciation on potential infrastructure capital investments. By definition, depreciation is essentially the phased "cost" of a fixed asset over time; typically, in conjunction with its useful life. By depreciating an asset (i.e. infrastructure equipment, renovations, etc.) an organization can account for its cost/expense over several years (vs. all at once). This concept can significantly affect the tax burden for organizations who pay taxes (i.e. for-profit healthcare entities), but it also affects the statements of financial position (external financial statement) for non-profits as well. To fully understand the long-term implications of an infrastructure decision on a facility business model you should understand how depreciation does (or does not) affect the organization's bottom line. Specifically, there may be additional return on investment to capture for infrastructure decisions where if their depreciation can improve an organization's bottom line.



Analyzing Infrastructure Needs

After the facility business model has been identified and key factors identified, it is now time to understand the facility mechanical, electrical, plumbing, and fire protection infrastructure needs. The new healthcare facility will typically either be a renovation of an existing space/building or new construction. In either case, infrastructure needs of the completed facility concepts need to be analyzed.

In a healthcare facility that is going to be in an existing space/building, and renovated for the new business, the first thing the engineer needs to do is conduct a due-diligence assessment and review the existing infrastructure systems conditions.

An experienced engineer will need to survey the existing facility infrastructure to determine the condition of the equipment. This survey will consist of visual inspection of the equipment to determine, age, serviceability and overall equipment type. One of the key determining factors in assessing the condition of the equipment is age. Determining the installed/manufactured date from the manufacturer's nameplate will yield the manufacturing period of the equipment. The equipment

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age can then be cross checked using industry standards for equipment life expectancy, this will allow you to discover if the equipment has surpassed its useful life expectancy. If the equipment is past its useful life expectancy it should be considered for replacement because catastrophic failure could be imminent. If it is within the useful life expectancy, then the engineer will need to review with the owner if it is worth being reused. The other key task of the survey is the visual inspection of the equipment. What the engineer is looking for is the physical condition of the equipment, noting any physical damage, evidence of replaced parts and any excessive wear and tear. With determination of equiptment age, and visual review, the engineer will be able to make an accurate assessment of the overall condition of the equipment.

Once the condition of the infrastructure equipment is determined the performance must be evaluated. The main goal in evaluating performance is to determine if the existing infrastructure has the capacity to support the needs of the new business. There are several methods for determining the performance of infrastructure, one method is to review the existing utility bills. In doing so you can determine how much power, gas or steam capacity the building has typically used. This however is only applicable where the whole building is being used, in a tenant, subtenant or partial lease of a space this method might not be enough information because the building utilities are shared. The most direct method for determining the performance of an existing infrastructure is through manufacturer's product data. If the infrastructure equipment manufacturer's nameplate is available, one can look up the manufacturer and model number to yield the capacity of the given equipment. Most manufacturer's keep records of all their equipment and can search either a model number of serial number. The third method for evaluating an infrastructure system performance can be done by metering of the system. Whether it be electrical, thermal or other metering this actual measurement can yield the capacity of the infrastructure component.

Once the exisitng condition and performance of the infrastructure has been determined and reviewed you can now analyze if the infrastructure is adequate to support the new business function(s). To determine this you must compare the infrastructure needs (mechanical, electrical, plumbing and fire protection) of the proposed new business with the performance and condition of the existing infrastructure. If the existing infrastructure cannot support the new business infrastructure needs, then the necessary upgrades will need to be identified and incorporated into the project needs.

"The main goal in evaluating performance is to determine if the existing infrastructure has the capacity to support the needs of the new business"

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If there are no existing facilities to review or the end user would like to build a new facility for their new business, then the engineer must essentially go through a similar process for the concept (or schematic design) to that of reviewing an existing infrastructure. In this process the following key factors of the new business need to be identified and analyzed: capability needs, performance needs, flexibility, reliability, redundancy and conformance to any existing standards they might have.

The proposed new business infrastructure performance requirements need to be determined. This is simply translated to how much power, heating, cooling, ventilation, and water will the new business need to operate. To determine the infrastructure capacity required of the new business the engineer will perform load calculations based on the proposed architectural plan and tasks being performed in the new space. The load calculation will yield the necessary information to determine the performance requirements of the new infrastructure so that the infrastructure can be designed to support the new business.

The topic of flexibility must be discussed with the new business end users when determining a new system infrastructure design. Discussions should focus on if the new business will function the way it is designed for the complete life term of the business model, or will there be the need to possibly alter the business. A change in services offered by the new business after construction, or the possibility of expansion, growth or downsizing, will all impact the infrastructure design. If the new business deems it possible that they may change use or function of the space, than flexibility in function needs to be reflected in the infrastructure designat the onset. Given the ever-changing nature of healthcare and services being offered it is becoming more common that healthcare facility infrastructure needs to be highly flexible.

The level of reliability of the new business's infrastructure also needs to be determined and coordinated with the business end user. There are many levels of reliability, whether it be emergency backup power via a generator, or redundant HVAC equipment so that during routine maintenance when the equipment is down the redundant system can operate with no disruption to the business. There can also be no reliability, where if there is an issue with the infrastructure or needed maintenance, the business will simply close or plans not to be operational on certain days. Reliability greatly affects not only the infrastructure system demands, but can be very costly both in upfront capital and ongoing operational costs. The discussion of infrastructure reliability needs to be brought up between the design engineers and end user and coordinated to be aligned with the business model.

Building a Full Integration Model

Once a full understanding of the facility business model and analysis of the infrastructure requirements (existing and/or new) has been completed, the next step in the alignment process is to methodically evaluate and fill any "gaps" between the business model needs and the existing/proposed infrastructure options (proposed being from conceptual or schematic design efforts). The specific goal of this gap analysis is to analyze each major infrastructure decision/option with respect to the business model components (i.e. capital costs, operational costs, rate of return, etc.) and finalize a fully "integrated" model which incorporates selected infrastructure decisions that are optimized for support of the facility business model needs.

Key to the success of the final integration model is the development of sound infrastructure options to weigh against the business model aspects. Insufficient optioning, including the lack of multiple

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options, and biased option development, can result in situations where the options presented do not fully represent the actual range of possible possibilities…the best infrastructure possibilities may never even surface for consideration. This situation is especially common in today's fast-paced design/construction environment, where scheduling and time demands can cause premature conceptual development and associated infrastructure optioning.

Understanding that development of infrastructure options is critical to get the best decisions (and thus alignment with the facility business model), the process of optioning is vital. The first step in optioning is creating a set of goals, following are three key optioning goals that can be used (at a minimum) in all development efforts:

Key Optioning Goals

Include input from broad perspectives – ***a good team***

Create using sound alternative development – ***a good ideation process***

Include both short term and long-term considerations – ***a life cycle perspective***

The first important goal of any optioning process is to get the right team members together for the effort. These team members need to have broad enough perspectives to represent the multiple angles of approaching the decision at hand. Specific to facility infrastructure decisions, this should not only include engineers/architects, but also facility users and operators, equipment providers, and installer/contractors. The latter two are often left out of the process due to the common design/bid/build process for typical facility infrastructure delivery. Consider using processes like early Construction Management ("CM" delivery) and various design-build/design-assist delivery methods to help bring in the equipment provider and installer perspectives at the critical optioning time.

The next key step in development of good infrastructure options is the actual process of ideation, or the process of building ideas. This process should be a formal, applied, workable, and learnable one and should not be treated in an ad hoc, unorganized manner. To start, the team first needs to prepare for it, both actively and passively. Active preparation can include activities like site visits to existing facilities, visits to vendor demonstration areas, etc. Passive preparation includes typical activities like web research, reading of white papers, talking to other experts, etc.

Once prepared the optioning team can begin the actual process of building ideas; this effort has some "standard" tools and methods as well. Ideation should begin with development of multiple ideas/options, statistically speaking, the greater the initial set of options the better the probability of obtaining the optimal concept(s). The most common tool for generating idea is brainstorming, but there are other effective methods as well, the methods of idea matrices and strategic questioning are both useful for facility infrastructure option generation.

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An idea matrix is a tool for putting together independent variables related to the function or problem at hand and arranging them in a horizontal and vertical "matrix" to generate as set of unbiased ideas. Below is a simple example of an idea matrix for generating heating options for building:

Types of Heating Equipment				
Interior Air handler (AHU)	Rooftop Unit (RTU)	Space Fan coil (FCU)		
AHU - Electric	RTU - Electric	FCU - Electric	Electric	Energy Source
AHU - Gas	RTU - Gas	FCU - Gas	Direct Gas-Fired	
AHU - Steam	RTU - Steam	FCU - Steam	Steam	

Heating Systems Idea Matrix

Strategic questioning is a method for taking a single option (maybe created during a brainstorming session) and developing additional options from that initial idea. Typical strategic questions used for this option generation process include:

- What's wrong with the current option?
- How can I improve the current option?
- Can I modify or adapt the current option?
- Can I magnify/increase the current option?
- Can I shrink/reduce the current option?
- Can I rearrange or reorder the current option?
- Can I substitute something in the current option?
- Can I combine some of the recent options?

One last goal for the creation of infrastructure options is to be sure to keep perspective on what an option's life span is and how it behaves/changes over time. The life time cost, or more commonly referred to as the "life cycle cost," is a key aspect of many infrastructure decisions. Life cycle costs are especially important to infrastructure as the typical piece of equipment or system's initial cost is most often a small fraction of the life time operating cost, and even a smaller fraction than the increase/decrease in user labor efficiency (and thus overall staffing/labor costs). Information from the American Hospital Association's (AHA) analysis of Centers for Medicare and Medicaid Services (CMS) data, shows that, on average, hospital healthcare organizations cost for wages and benefits to support staffing accounts for more than 50 percent of their organizations total expenses.[5] Improvements to the efficiency of staff working in these organizations (i.e. from improvements to infrastructure) can compound to create much larger returns on investment. One paper presented by a member of the Lawrence Berkeley National Laboratory determined that productivity decreases of approximately 2% for every degree of space temperature above an internal design temperature of 76.5 deg. F.[6] Working this out for a facility with just 50 employees, working single shifts, and with average annual FTE cost of $150,000/FTE (salary, benefits, etc.) results in an additional cost of approximately $150,000/yr for just one degree above the 76.5 deg. F. threshold.

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Once you have created what you believe are the appropriate options for you particular building infrastructure decisions, the last step in developing the final integration model is to evaluate those options and "close the gap" between the infrastructure decisions and facility business model. There are several tools and methods that can be used to evaluate options and weigh strategically against the facility business model.

One common method is deducing the options/decisions into a matrix that includes the life cycle considerations of capital cost, energy costs, maintenance costs, and life span expectancy. By essentially reducing the economics portion (capital and operational costs combined with life span) to a true life cycle cost, you can then compare the options against the facility business model goals to check for alignment. Specific check points include conformance of the infrastructure option's life cycle payback to the business model's desired rate of return, and consistency of the life cycle cost analysis timeframe with the business model's timeline. If a particular infrastructure option's life cycle payback (savings to investment ratio) exceed the business model's desired rate of return, in the timeframe of the business model, the option is essential viable and aligned.

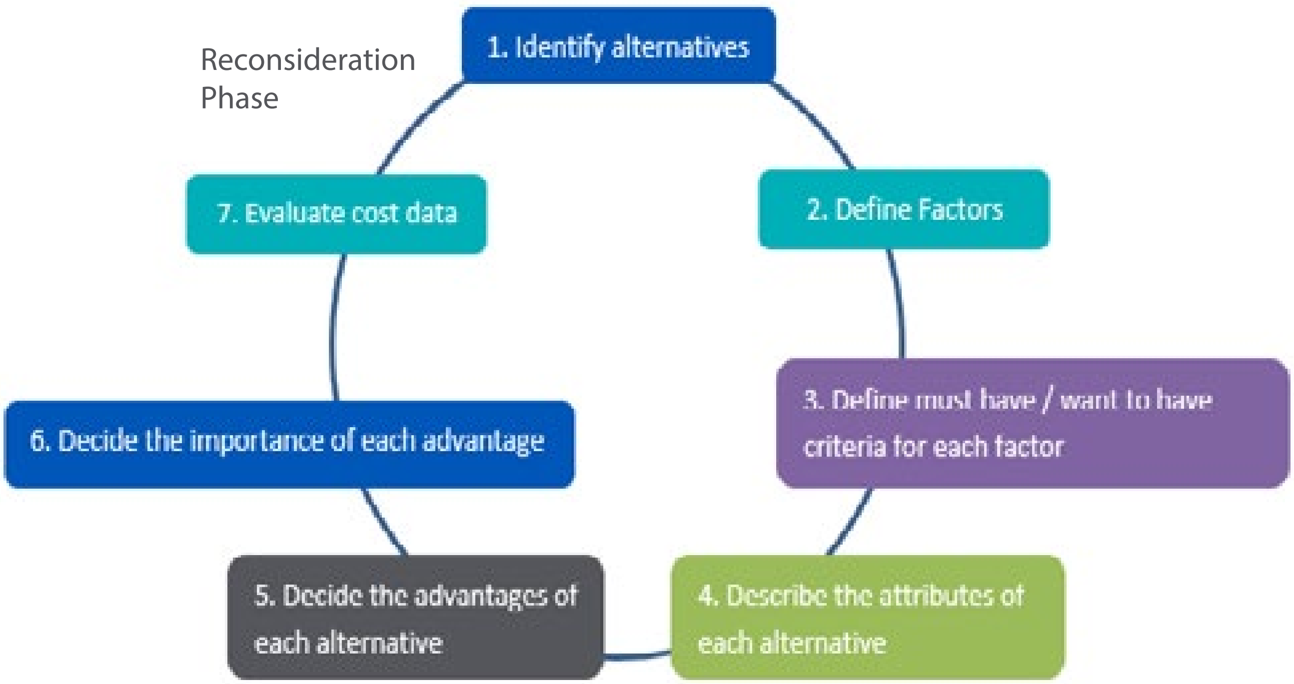
HVAC Systems

OPTION DESCRIPTION	LIFE CYCLE CONSIDERATIONS	PROS	CONS
Option 1: **Basis of Design** • Water-cooled high-efficiency, modular, chiller(s) • Condensing, hot water boilers • Closed-circuit cooling towers (for process and environmental cooling) • Multiple, modular, variable flow, indoor mezzanine mounted, air handlers • Variable flow hydronic systems (chilled and hot water) • Roof mounted exhaust fans	Initial: Higher Operating: Lowest Maintenance: Lowest Life Expectancy: 25-30 yrs Flexibility: Maximum	• Higher efficiency = lower operating costs • Units would be located inside, therefore maintenance would be easier and lower cost. • Better controllability with hydronic. • Makes future expansion easier, as the chillers and/or boilers can be provided with additional modules. • Much longer equipment life span • More unit options available (interior lights, windows, humidification) • No major roof equipment (no screening required) • Units would not require exterior dunnage for support.	• More expensive • More interior building space required.
Option 2: **Packaged Rooftop Based** • Packaged rooftop air handlers (RTU) • Gas-fired furnaces within RTUs • Air-cooled, direct expansion cooling within RTUs • Closed circuit cooing towers for process cooling only • Roof mounted exhaust fans	Initial: Lower Operating: Highest Maintenance: Highest Life Expectancy: 15 yrs Flexibility: Low	• Less expensive • Less interior building space required.	• Majority of equipment located outdoors; maintenance more troublesome and expensive. • Lower flexibility to add capacity. • Less controllability with gas heating, DX cooling. • Higher energy use (gas heating and packaged DX less efficient than hydronic) • Units would require exterior dunnage or reinforced roof support from below with wide flange beams • Units require screening for aesthetic concerns. • Much shorter equipment life spans.

Example MEP/FP Integration Matrix

A life cycle evaluation concept is a good first step to ensure at least the economics of any infrastructure decision is aligned with the facility business model. Just looking at economics alone, however, can lead to a less than fully optimized evaluation. To fully close the gap, other factors in the facility business model need to be brought into the decision-making effort. Specifically, factors like, construction schedule impact, branding, flexibility, and reliability (essentially risk). To include these factors other methods, like the LEAN method of "Choosing by Advantages" (CBA) can be used. In LEAN CBA, alternatives (options) and attributes (characteristics like reliability, flexibility, etc.) can be used to together to ultimately develop the advantages or the postive difference between the attributes of two options. LEAN CBA is helpful when several subjective attributes may be just as important (or even more important) than just economics.

CBA Steps



It goes without saying, that the final success of any infrastructure options decision must ultimately be buy-in for all parties involved. In the case of infrastructure decisions, the buy-in group should essentially include all those members originally identified in the optioning team. So how to you get buy-in? There are many studies and methods on this, but most break down to the following key components:

1. **Get team members involved and excited** – engage the team, solicit feedback, and communicate progress with them.

2. **Explain "Why"** – don't assume all team members know why you made a decision or what factors went into it. Publish the method you used and the factors that went into the final decision.

3. **Be overt about the perspective of time** – Explain how the decision works for today, tomorrow, and future.

4. **Don't discount emotions** – demonstrate how the benefits of your decisions but be sure to fully listen to dissent and take it seriously.

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CASE STUDY #1
RELIANT MEDICAL GROUP FACILITIES

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3 Case Study #1

Background

The Reliant Medical Group Facilities Replacement project involves the reorganization and redevelopment of 18+ existing program functions into nine new facility locations. The new facilities include a mixture of ground-up construction, existing building renovation, and shell space fit-out. Included in the renovation portion of the work are several "big box" location conversions of original retail stores to outpatient medical clinics. The overall project builds over 400,000 SF of medical outpatient spaces to provide primary and specialty care, laboratory, diagnostic imaging, endoscopy procedure, and associated support functions. The project is a key component of the overall strategic approach to Reliant Medical Group's care delivery system and is designed to ensure modern, efficient, and regionally competitive patient care for Reliant Medical Group's patient population now and into the future.

Courtesy of Lavallee Brensinger Architects

Business Model

With respect to the facility business model for the Reliant Facilities Replacement project, the driving factors for the model's success include project budget, schedule, and staff efficiency factors. All three major success components needed to be aligned with final infrastructure decisions to ensure overall project success.

The project's internal scope included the cessation of 15+ existing space leases; the lease end dates, coupled with the reprogrammed locations of the relocated space functions, essentially created the overall project schedule. For Reliant to continue to serve their existing (and new) patients without a break in service (and thus loss of revenue), the relocated functions "new location" needed to be complete prior to existing lease end date.

The business model's overall budget reflected the significant amount of simultaneous facilities construction, costs of new land acquisitions and fit out of the new facilities with both relocated existing and new equipment. The latter was substantial as existing program's equipment is to be online and functioning at the original location right up to the opening of new spaces. The project budget broke down to an average facility construction cost of approximately $315/SF, land

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acquisition costs of approximately $33/SF, and owner soft costs (fees, equipment, furniture, permits, etc. of approximately $100/SF.

Lastly the business model predicts anticipated improvements to overall existing staff efficiency. These efficiencies will result in a significant increase to the potential serviced patient population (total capitated patient capacity) from the new program layouts and location consolidations.

Infrastructure Analysis – Existing and New

Program needs were developed (through strategic planning) for each general geographic location, followed by real estate investigations to determine potential building/building site locations. Since the project includes several new facility locations, with some new buildings and some existing, the initial infrastructure due diligence efforts varied for each proposed location. Many locations were initially reviewed and ultimately several didn't make the final list. For existing locations with in-place infrastructure, the first step in the analysis included a high-level investigation of the available systems and potential for reuse or upgrade for support of new program needs. Careful attention was paid to the ultimate renovation/upgrade requirements, important to the evaluation was the duration of potential upgrades, new equipment lead times, and overall anticipated costs of upgrade.

Concurrent with the initial real estate investigations, and immediately following the strategic program development, the design team began development of prototype infrastructure systems information. This process included creation of concept level system and equipment configuration options, square footage-based energy models, savings-to-investment models for various options, and procurement strategy discussions for major infrastructure needs (air handlers, switchgear, generators, etc.). The goal of the prototyping effort was to develop information and options that ultimately were evaluated against the business model (via Integration Model development) and become the basis of design infrastructure concepts at each new facility location.

Integration Model

Following the development of the due diligence information and initial infrastructure prototype options, the next step in the infrastructure/business model alignment process was the creation of a final Integration model that summarized the information investigated to date, laid out the potential infrastructure options, analyzed them against the business model needs (i.e. capital costs, operating costs, schedule, etc.) and presented final set of concepts with full team (owners/users, designers, and constructors) buy-in. To arrive at the Integration Model several tools were used, the two "primary" being LEAN "A3" and "Choosing by Advantages" methods. Specifically, a large, multi-tabbed (for each infrastructure system) set of option matrices with description, capital and operating cost, and pro/con data was created. The inputs to these matrices came directly from the initial prototype concept work and due diligence efforts. The matrices' data was then summarized into LEAN A3 worksheets and meetings/workshops held to compare the information against the business model needs (often using the LEAN choosing by Advantage methods) and decide upon the final basis of design decisions.

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Results

The results of the Reliant Facility Replacement project's attention to infrastructure decision and business model alignment demonstrates the benefits of the process, specifically regarding capital investment and schedule. At the time of writing, eight of the nine facility designs have been completed and brought to (or beyond GMP). The results of the GMP efforts show the average MEP/FP infrastructure costs/SF across all facilities to be $91/SF; this is within $1 per SF of the original business model's (pre-schematic design estimate) of $92/SF. Additionally, the overall range of MEP/FP GMP costs all fall within the $84 and $107/SF range; notable in that the current bidding spans eight different sites and over a bidding time frame of 16 months.

With respect to success against the business model's critical scheduling needs (and thus program relocation/startup/etc.); the original business need was for all facilities to be open and ready prior to original location lease ends. At the writing of this guide (July of 2018), the Facility Replacement project has four facilities complete, four others under construction, and is on track to successfully open all nine of the program relocations/replacements prior to original lease end dates.

Lessons Learned

Below some current lessons learned developed from the Reliant Medical Facility Replacement project and the infrastructure to business model alignment efforts:

- Finalization of strategic equipment/material decisions are important for procurement timing/schedule success. In the case study, changes to the final emergency generator sizing required "shifting" of generator deliveries from one site to another to ensure availability of emergency power prior to facility opening.
- Careful attention to all infrastructure systems in any prototyping, concept phase is critical to both schedule and cost control. In the case study, the tel/data infrastructure systems were not fully vetted and developed in the prototype concepts and ultimately construction timeframe changes required to meet the needs of the user functions.
- The initial due diligence phase should include outside stakeholders like utility companies to ensure cost and schedule alignment with the business model. In the case study, late obtainment of available gas pressure data caused construction time frame changes and costs.
- Attention should be given to all operating costs in the business model development. In the case study, energy costs for buildings was part of the decision making (i.e. lower costs weighed as a benefit), but the baseline energy cost targets for the building were essentially an output of the process vs. an input.
- Complete understanding of the bidding and procurement environment early in the due diligence and analysis phase is important to enable a full range of options for infrastructure components. In the case study, fully integrated (smart) low voltage systems (combining of building automation, tel/data, security, nurse call, and all other low voltage systems into a single procurement) was a desirable option; the project was unable to fully implement this option into the bidding process due to late implementation into the design and less than full bid environment investigations.

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CASE STUDY #2

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4 Case Study #2

Background

The United States Department of Veterans Affairs (VA) Community Care Center project involved the construction of a new 60,000 sf facility serving the West Haven, Connecticut area veterans. The new center focuses primarily on providing mental health, group therapy, and primary care services. The center serves as a central place for veterans in the community to come, socialize, exercise and receive career skills training and a meal if needed. Unlike the traditional VA centers, this building would not be owned by the VA but would be a leased facility. In the public solicitation for offerings (similar to an RFP) for this project, the government was looking for bids from a developer who would construct a building to fit their requirements and program; and would ultimately serve as their landlord for a duration of twenty years. The developer's team (construction manager, architect, and engineers) was responsible for submitting a bid to the government that included a full schematic design level package. In addition to typical schematic level plans and MEP system descriptions, the bid was also required to include an overall life cycle cost for the building and all building operations. This lump sum cost was for the duration of the 20-year lease and broken out into monthly lease costs that included rent, cost of maintenance and facility construction cost. The overall goal of the solicitation for offerings was to get a final dollar amount on what the new facility (owned and operated by someone else) leased by the VA would cost for the next 20 years.

Business Model

The business model for the VA is to obtain a new facility at a known total cost for a 20-year lease within a price range that they've set. This range of total cost is known as the "competitive range." It's the goal of the bidding team to align their proposed cost within the competitive range. One major component of the process for adjusting the bid into the competitive range is the design (and associated construction and operation costs) of the engineered infrastructure. To successfully get the bid within the competitive range, the engineering infrastructure systems essentially go through a value engineering process where systems and equipment are continuously altered in an effort to adjust the bid price. It's important to recognize that this bid price is an all-inclusive price that the VA will pay, which includes the acquisition of the site, the construction of the building, the operating cost of the building and the maintenance efforts. During this process it's paramount that all decisions, whether it be the mechanical system, or the toilet paper dispensers and how often they need to be refilled, be aligned with the bidder's price. If these are not aligned, then the bidder may have just committed themselves to a 20-year rental agreement where they could potentially be losing money.

Infrastructure Analysis

In this bid process it is extremely important that engineering infrastructure systems are well vetted and in alignment with the business model to make the project financially successful. For this project, multiple engineering systems we analyzed for how they aligned with VA standards of design and the developer's business model. During rounds of

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costing and adjustments to achieve a bid within the competitive range, it was discovered that strict adherence to the stringent VA standards was driving costs out of the competitive range. These "client standards" were actually preventing them from achieving a building that they could afford. To solve this problem, the design team proposed changes to the infrastructure that would still meet the intent of the VA standards, while varying from the letter of the requirements. One of the first items looked at was the significant requirement for emergency generator power to back up the facility. This was a requirement the VA had, but once analyzed, the building program (which was strictly outpatient medical offices and group therapy rooms) ultimately did not need full back-up power. The operational intent was actually that If the facility lost power they simply wouldn't continue to be open for business. Another infrastructure system reviewed was the requirement for chilled water cooling systems. A chilled water system was not only costly up front, but added to the general facility maintenance cost. In switching from chilled water cooling to air-cooled, direct expansion refrigerant systems, the team not only eliminated equipment from the project and decreased the maintenance cost. It was important that all team members were involved in the infrastructure analysis, as adjustments to the MEP infrastructure needed to be tracked and priced by the construction manager, communicated back to the developer and the final bid adjusted.

Integration Model

The fully aligned integration model for this project took into account all MEP/FP infrastructure installation and operation costs, as well as all aspects of the building design and operation. The integration model for this project was essentially the developer's bid to the VA for the project in its entirety. In the rounds of bidding, the project team developed MEP/FP and architectural schematic design concepts which the construction manager would produce cost estimates for. Each bid included all development costs and a final proposed rent amount for submission to the VA. The VA would review and when the bid was outside the competitive range, the design team would reassess the design and resubmit. Through the bid process there were several rounds of resubmissions, at each point an infrastructure system would be re-analyzed and cost estimates adjusted. Input in the final selection of the systems described in the schematic design package was from all parties, the engineering team for performance and reliability, the construction manager for cost estimates and the developer for operational costs/impact. It was through this continuous collaboration effort that the project team was ultimately able to finalize a schematic design concept for the VA that met both their programming needs and was within the appropriate competitive range.

Results

The results of the project's focus on infrastructure systems alignment with the business model proved that through collaboration of a cohesive developer, architect, engineer, and construction manager team, a design could be tailored to ultimately fit a fixed 20-year total project cost. The effort showed a client could set a price on what they would invest in a building for a full 20 years. At the time of writing, the building has been fully designed and has broken ground for construction. The design has been strictly adhered to and the bought-out construction cost for the building remains unchanged from the initial bid submission. During the

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design process there were some requests from the VA to add things, these items are tracked and these costs will be outside of the developer budget; paid separately by the VA. The life cycle cost analysis and energy modeling shows the operational costs of the infrastructure will also stay within the developer's (and VA's) desired costs. In the end the project team not only delivered a design that ultimately suited the VA's needs but also fit into the developer's business model.

Lessons Learned

Below are some lessons learned developed from the VA West Haven Community Care Center project and the infrastructure business model alignment efforts:

- You need a fully integrated team of all parties (end user, architect, engineer, construction manager) to accurately align the business model with the infrastructure.
- When deciding on infrastructure systems, the engineer needs to not only think about the system performance, but also the operational impact of the system. If the building is not going to have an in-house facilities/maintenance staff that too must be carefully factored into the design.
- At time, a client's standards could actually increase their construction and operational costs above their business model requirements. Standards should be reviewed carefully and confirmed if they are also in alignment with the business model for a facility. If you blindly use standards that are stricter than they for the building, they may push the cost of the project outside of its competitive range.

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