Introduction

The assessment of five hospitals and the corporate headquarters buildings in the Omaha, Nebraska metro region has been undertaken with the use of two strategic tools used to determine the “green and sustainable” performance of an existing building. First, the proprietary registered Eco/STEP℠ assessment tool created by the Joslyn Institute for Sustainable Communities defines measurable sustainability indicators within the five domains of conditions of sustainability that generally apply to each of the campuses. These indicators can be tracked and accounted for at performance levels over time, throughout the life-time of each facility. Second, the LEED standards for performance of materials, systems, and products associated with existing buildings, as defined by the US Green Buildings Council will be used as a guideline for recommended changes and retrofits to each of the existing facilities. The performance of these elements, once installed in the facility, can be utilized to account for the measurement of the various sustainability indicators over time.

The Five Domains of Sustainability in the Built Environment

The Five Domains* of Sustainable Development: A paradigm for Design, Planning, and Urban Management (*"Domain” in this context is used to mean: “…a field of human activity, with similar features, information or concerns.”)

If the public/private sectors are to have a reasonable chance of managing the growth of the urban habitat, and at the same time achieve a balance of economic development with the conservation of the earth’s natural systems, we must expand our definition of the principles of sustainability. We must see the problems in a whole-systems context, rather than in a one-dimensional, single-issue context.

During the first official recognition of the concept of Sustainable Development by the United Nations’ Bruntland Commission (World Commission on Environment and Development, 1987), it was stated that a principle of sustainable development was necessary to protect the natural systems of the earth, and that
the principle should “…ensure that development meets the needs of the present without compromising the ability of future generations to meet their own needs.”

Since the beginning of the concept and the subsequent studies on implementation, sustainable development has consistently been represented as having three domains – the environment, economics, and the social context – and, that they must be treated interdependently for a sustainable balance to occur. Many business and governmental leaders have been skeptical about placing any domain on a par with economics. Even those who, sooner or later, will adopt the values of living in balance with nature often find the tools and the reach within these three domains to be limited.

The limitations in achieving real sustainability exist whether the scale of the development is at the micro level (such as an individual building or neighborhood), or at the macro scale of habitat (such as a city or a region of urban and community habitats). The designer, the planner, the developer, the civic official, or the NGO leader who is genuinely interested in facilitating a sustainable solution in the urban context will not find all the networks or ingredients, or all the information, or all the tools and alternatives for solutions within only these three domains.

Therefore, on the basis of these and other examples of our continuing and widening gulf of separation between human systems and natural systems, the Joslyn Institute has developed project evidence that the Five Domains of Sustainability, for humanity, bio/eco-systems, communities, and the earth are:

- Environmental (natural and man-built),
- Socio-cultural (history, conditions, and contexts),
- Technological (appropriate, sustainable),
- Economics (the production of goods and services within a sustainable context, and the financial resources to support the production, trade, operations, and maintenance),
- Public Policy (government, or public rules/regulations) (see Figure 1) (JISC, 2003-6)
Further, in the city of the future these domains should be the organizing principles for urban administration, urban design and planning, urban growth management, and regional and urban sustainable development. The domains, and all the information contained within them, are interdependent, interactive, and affective, one in turn upon each of the other four. A systematic analysis of their interdependencies, in any developmental or operational situation, will reduce the potential of unintended, unanticipated consequences, at any scale of development.

**Sustainability Indicators and the EcoSTEP\textsuperscript{SM} Tool** Measuring or projecting the improvement or decline of various quality of life factors over time is clarified using the EcoSTEP\textsuperscript{SM} tool. Symbolizing the cyclical quality and interconnectivity of all living systems, EcoSTEP\textsuperscript{SM} is an effective tool for plotting various sustainability indicators in three term, or time, ranges – short-term (S), medium-term (M), and long-term (L) – each divided into ten time frames that can be defined by criteria that the use may choose (i.e. one year, ten years, etc.). (Figure 2)
In an ideal world, an indicator (for example, water quality), plotted near the outermost ring of each term scale would be considered, or judged to be approaching the best possible outcome or condition for sustainability.

In this example, short-term conditions appear to be approaching optimal, yet the relative immediacy of medium- and long-term measures indicate water quality challenges that lie ahead. For further detail, the dots plotted on the scale can be color-coded and sized according to the urgency or scale of the challenge of that particular indicator.

The EcoSTEP℠ tool allows any user to assess hypothetical yet real life situations, or real conditions of design or planning intent, to assess the assumptions for consequences and trade-offs, and to communicate those situations to stakeholders and leadership. By incorporating all five domains the tool is effective both in gauging progress and in revealing the various and complex trade-offs that will occur between indicators.

This graphic representation of issues and conditions makes EcoSTEP℠ an ideal tool for collaborative planning as well as for communicating to leaders and the public a region’s, or a project’s, progress toward a sustainable vision and quality of life goals. The Joslyn Institute has applied the tool to a diverse range and scales of built-environment projects, including individual buildings, neighborhood contexts, small communities, districts within cities, and to large regions.
Sustainability Indicators Recommended for Explicit Application to the Assessment of Alegent Health facilities:

I. Existing Buildings (summary from the LEED standards for Existing Buildings)

Environmental Domain:

A. Water conservation measures (interior, and exterior stormwater management and landscape practices)

- It is important to reduce the consumption of potable water use for building functions – such as sewage conveyance and irrigation – so that it may be preserved for more critical functions, such as drinking and washing. Water conservation methods should include employing low-flow plumbing fixtures, dual flush water closets, water free urinals, efficient dishwashers and laundry washers, as well as integrating sensors and time stops on faucets and shower heads (in all locations that do not conflict with health-care standards).

- High efficiency irrigation systems with moisture sensors should replace the standard time-cycle systems now employed. Where possible, rainwater collection systems and/or campus grey water systems should be employed to supply the irrigation systems.

- Consider changing surface parking lots from impervious material to pervious surface material to reduce rainwater runoff and polluting residue from auto waste. Consider the installation of runoff water cleansing rain gardens on the campus sites in natural topography locations prior to runoff entering the community sewer systems. Also, consider the installation of rainwater collection and landscape distribution systems at each campus. (In the near future the entire city of Omaha must comply with a federal mandate to separate solid waste sewage and stormwater runoff. All large sites, such as the hospital campuses in the metro will be affected.)

- Sustainable landscape practices should include low emission and energy efficient mechanical maintenance equipment (this requirement should be a condition of employing landscape contractors, or Alegent-owned equipment), installation of low water, drought resistant native plants, the use of grass clippings, leaves, and food waste compost materials for landscape fertilization in lieu of chemical fertilizers.

B. Carbon emissions reduction

- The current power supply to Alegent facilities is produced primarily by inefficient carbon emissions coal-burning power plants. Consider new agreements with the Omaha Public Power District (OPPD) for a percentage of power supplied by renewable energy sources.

- Also, to benefit the reduction of a carbon footprint, consider the installation of on-campus energy generation technologies such as solar powered photovoltaics and/or wind
能源。随着资金的可用性增加，现场和购买的电能的增加将是一个战略机会。（见技术指标）

C. 绿化/景观美化

- 考虑树种植政策以抵消Alegent校园的碳足迹。例如，每座医院校园的每出生分娩都会是一个重要的奥马哈大都市森林化项目，也是一个很好的公共兴趣项目。树木的种植地点可以是Alegent的财产或附近的公园和社区。这项政策将被认作是减少Alegent碳足迹的额外手段。

社会文化领域：

D. 室内空气质量/健康环境

- 运营变化可以改善室内舒适度，同时包括节能措施，如 HVAC夜间后退，以及在适当的区域增加校园冷却水供应，当外界空气温度降低时。为了提高能源效率和室内环境质量，Alegent应考虑以下改造：
  - 高效电机安装，当需要更换时
  - 变频设备安装在所有超过10HP的电机上
  - 变频空气流量系统安装，以替代不高效的恒定空气流量系统，以实现更高的效率。

E. 将病人住宿质量与Alegent医疗质量观和实践相匹配

- 自然光采集、电气照明的节约、西方和南方立面的热量通过不高效的窗户和外部建筑热壳会增加病人的舒适度和员工的生产力。将病人住宿质量与Alegent医疗质量观和实践相匹配将增强病人满意度和员工生产力。

F. 安装绿色内容，回收和废物流减少实践

- 考虑任命一个校园“绿色团队”的企业监督员，负责管理回收和所有消耗性产品的废物，包括包装和废物的使用、食物服务和病人护理操作。

Technologies Domain:

G. Apply on-site alternative energy generation systems

- The majority of the roof structures of the six campus facilities are flat constructions. These locations are ideal for the future installation of solar and wind powered technologies to supply a portion of the off-grid electricity for the campus. Installation of 1,000 sq.ft. of photovoltaic cells can produce 10 kilowatts of clean, renewable energy, or for larger installation calculation, estimate a 6 acre installation to produce 1 megawatt of energy. Current installation costs range between $5.00 - $6.00/watt. (re: Weston Energy Systems, Omaha).

- Employee parking lots also provide ideal “public awareness” opportunities for the installation of photovoltaic systems on parking sheds constructed over portions of the surface lots.

- The flat roof systems should, in the future, be considered for the installation of heat reducing white surfaces, or green-roof installations, and rain-water catchment systems for landscape maintenance uses. Green roofs can be expected to reduce the energy consumption of a building by as much as 30%.

H. Install energy conservation technologies wherever possible

- Many incandescent light bulbs have already been replaced with compact fluorescent light bulbs in the Alegent facilities. A regular maintenance cycle of three to five years, and replacements of all-CFL bulbs is recommended.

- Other recommended technologies include: motion/occupancy sensors for light switches in areas that do not have constant occupancy, replace CRT monitors and televisions with LCD, offer low-wattage task lighting to staff locations, replace electric radiant heaters (if any) with electric resistance heaters, identify laptops, computers, fax machines, copiers, scanners, water coolers, microwaves, and refrigerators that are not Energy Star rated and replace them accordingly. Also, identify all appliances and business equipment that can be switched off in unused hours.

- Consider appointment of a “Green and Sustainable Systems Coordinator” for each campus that would oversee the reduction of energy consumption through occupant education programs, demand-side management practices, meterings, energy-saving improvements to buildings, conducting energy audits, and initiating energy reduction programs. The coordinator could also oversee waste management programs, green purchasing, and staff “green teams” on each campus.

I. Install energy monitoring technologies (see also Economic Domain)
Joslyn Institute for Sustainable Communities

Sustainability Assessment

- Each building should have independent metering and monthly consumption metering, and accounting, for electrical, gas, chilled water, potable water, grey water (if any), and rainwater recovery and use.

- An infrastructure for real-time monitoring of energy and water usage at all the major campuses should be developed and tied into the “Siemens Control Center” located at the Bergan-Mercy campus.

**Economic Domain:**

J. Install energy/cost accounting system utilizing monthly Energy Consumption Technology; report system costs on a quarterly basis

K. Calculate design and installation costs of retrofit technologies and the expected payback schedule for resulting energy savings.

L. Calculate economic/environmental cost-benefit conditions for carbon footprint reductions due to phased retrofits.

**Public Policy Domain:**

M. Publish a “Facilities Maintenance/Operations Manual for Sustainability” for each campus, with specific corporation-wide standards.

- Components of the Operations Manual, at a minimum, should include frameworks for:
  - Energy and Water Conservation
  - Stormwater Management and Landscape Practices
  - Improvement of Indoor and Outdoor Environments
  - Materials and Waste Management
  - General Operations (including patient and staff environmental and operational benefits)

N. Negotiate a Building and Safety Policy with the City of Omaha and each of the other related jurisdictions, and operations and economic impacts with MUD, and OPPD for on-site energy generation and conservation measures.

- The local, applicable, municipal Building Codes and Ordinances should be investigated, and negotiated with local authorities, for barriers to the corporate plan for sustainable development and operation of the several campuses (i.e., Fire Marshal restrictions on waste management in Omaha, and restrictions of access to conveyance means through public transit system for Alegent employees, patients and visitors in Papillion.)

O. Organize a phased corporation-wide “Sustainability Master Plan” for retrofit designs, future construction, and modernization installations.
II. “Generation Patient” New Construction

JISC representatives conducted interviews with Gordon Malm and engineering consultant representatives Eric Sherman of Specialized Engineering Solutions, and Brad Johansen, Philip Schreier, and Dennis Basich of Farris Engineering to gain an insight into the planning and decision-making for Alegent’s “Generation Patient” new construction, now nearing completion. (see attached report, “Combined Notes, New Construction”)

The report highlights the dynamics of attempts by the Alegent Corporation to create facilities through the new additions that would be conservation-based, healthy and sustainable. However, due to budget constraints and various other design and planning decisions very little of the new construction, other than new HVAC technologies, would qualify for the new LEED standards for new construction. In other words, while there will certainly be new operational efficiencies and patient accommodations in the newly constructed additions to the hospital campuses, the overall improvements to energy efficiencies and sustainable, conservation-based operations will be only slightly improved when the additions come on-line.

III. Future Construction, Retrofits, and Overall Sustainability Assessment

The attached EcoSTEPSM diagram (see Figure 3) plots the primary sustainability indicators for the five domains of sustainability, in a summary fashion for the aggregate of the six facilities assessed by JISC. A quick glance of the plots and the diagram shows that none of the five domains are in a current state of sustainability. However, some of the indicators are in a stronger, more positive condition than others. If the Alegent Corporation is genuinely interested in moving its facilities and operations to a “green and sustainable” condition, this assessment tool can be converted into a strategic planning vehicle with alternative priorities and time-sensitive goals established for each of the sustainability indicators.

The next cycle of upgrades, retrofits, and new construction will need the planning of higher priorities for conservation-based energy efficiencies, daily operations, and patient accommodations to achieve the recognized national standards for health-care sustainability.
Combined Notes for the Alegent New Construction

Gordon Malm Meeting 07/20/09

Farris Engineering Meeting 07/29/09
In attendance:
Eric Sherman – SES
Dennis Basich – Farris Engineering
Planning and Design

Master planning and budgets for the renovations were completed in mid 2006. There was a specific documented design program before the actual design took place. The original programmers for the renovations were KSA in Minneapolis, but HKS in Dallas followed up, continuing, and eventually completing the program. HKS should have a copy of the program documents for each of the facilities. All of the additions are under the same contract with HKS and HBA as a joint venture. The designer looked at guidelines and tried to make renovations based on site characteristics including orientation.

Alegent Green and the Green Guide for Health Care

It was the intention of Frank Emsick to focus on the sustainability of the corporation, which manifested the idea of Alegent Green. Discussion of Alegent Green took place in the spring of 2007 after the master planning and budgets had been set. In addition, the schematics were also done before the Alegent Green discussions. It had previously been discussed that the goal was to create a LEED building, but this was out of reach due to the amount available for capital investment. However, Alegent hopes to undertake a LEED building in the future, but in the meantime would like to green the existing facilities.

Since LEED for healthcare is still under development, Alegent looked toward the Green Guide for Health Care (GGHC) for guidance during their renovations. This was done voluntarily and Alegent looked to incorporate points from the GGHC into their facilities. From the GGHC, the Alegent Green List was created consisting of potential targets for projects. The Green Guide for Health Care is still evolving, but the LEED for Health Care Rating system is also being developed based on the GGHC. Like the LEED system, the GGHC consists of Prerequisites and credits that hold point values. The renovations at Alegent met reasonable compliance with the budget, but the GGHC was not specifically followed. When determining which credits would be incorporated in the renovations the usefulness, point value, and feasibility of the credit was considered. Each credit they chose to design around was heavily debated before it was implemented.

During design, white roofs at all of the facilities were considered. In addition, a green roof was considered at Immanuel, but this idea was taken off the table eventually due to monetary constraints. There was a similar discussion of a green roof at Bergan as well.

During discussion of Alegent Green, they considered having one high profile specific green initiative per campus. At the time, a white roof was considered at Bergan, where impact to the site was minimal due the construction consisting of mainly vertical growth. A green roof was considered at Immanuel, low flow and dual flush fixtures as well as occupancy controlled airflows at Lakeside, recycling at Midlands, and low VOC materials at Mercy. Of these initiatives those that were carried through were at Midlands, Mercy, and the occupancy air flows at Lakeside. The occupancy air flows at Lakeside occur in administrative areas during off hours when the airflow is setback.
The mechanical, electrical, and plumbing for the five hospital renovations was split up between SES and Farris Engineering. SES focused on Mercy, Midlands, and Lakeside while Farris Engineering worked on Immanuel and Bergan. It was a challenge to the engineers to incorporate systems into the designs that would lead to savings. Part of the goal in the renovations was to integrate some of the systems of the facilities, update the systems incorporated, and meet new energy goals in regards to lighting. Alegent was and still is aware that it was necessary to move up in efficiency status.

Siemens and the HVAC Systems

During “New Era Construction” in 2001, the goal was to put in one operating system that would function throughout all of the facilities. This occurred with the use of Siemens controls with the exception of Immanuel where part of the facility is still on Johnson controls. Part of “Generation Patient”, currently underway, was to exert some more effort toward the operating systems. However, this phase of construction is geared more towards the patient than toward the buildings in particular. During “Generation Patient”, new HVAC systems were incorporated for the new construction, but the existing HVAC was only changed where the new and old systems came in contact. The new construction brings all of the facilities up to new systems with better efficiencies, and standardization was attempted among all of the automatics but not the pneumatics. All of the Siemens controls are stand alone, but are connected back to Bergan. The buildings within each facility are optimized by the system program but not in a wider scope. At Lakeside, the HVAC is premium efficiency with new equipment. Midlands was updated to be 5-6 generations better and the air filtering was upgraded.

In the HVAC system the engineers went for less pressure and did not use high velocity because the CFM per hp was inefficient. Both SES and Farris Engineering went with lower velocity systems that tend to use more space but required less pressure making the system more power efficient since the CFM per hp was more efficient. Variable speed drives are now used at lower pressures. Fan Wall technology provides optimal performance in a specific range and variable volume systems allow for patient room control. Patient rooms require six air changes but rooms with windows that experience sun exposure may need up to ten air changes. The HVAC system has the capability of raising and adjusting air changes. Due to the increased loads on patient rooms due to sun exposure, small brows at Bergan and Immanuel would be helpful. Brows over the south facing windows would be permissible, but brows or wings on the east and west are not desired since they would be so large and consequently block views out of the windows. The blinds could be useful, but are not effective since there is no control over them. Another problem with the patient rooms is the ceiling heights. The ceilings are often ten feet high. These high ceilings result in the use of 25% more energy to change out the air in the rooms.

Water Consumption

Given the GGHC, there is not a lot of difference in water consumption for the new construction. However, there is low flow and automatic plumbing in the public and administrative areas. There is not in the patient rooms because of bedpan service in at least half of the rooms. In addition, it is necessary to have hot and cold water in the rooms making it difficult to have sensored fixtures. None of the facilities are currently segregating grey water or storing rainwater.
McCarthy is the general contractor, out of St. Louis, along with MCL in a joint venture. However, MCL stepped out 3 to 4 months ago. After the contracts were done with the contractors, Alegent challenged the contractors to do some recovery and recycling although it was not included in the contracts.

### Hospital Specific Information

When working with the design at Lakeside, they were met with challenges regarding storm water detention. During construction, solar powered snowmelt was considered, but there was not enough roof area for panels to make it successful. At Lakeside revolving doors had been considered, but they were removed per the legal department. The result of this action was utilizing automatic doors with deep vestibules. However, the doors are set in a direct line which allow for the loss of a considerable amount of conditioned air. In order to mitigate this problem the doors could be offset in order to get rid of the direct line. It was previously considered to use a greywater system at Lakeside, but this was not followed through.

Bergan generates electricity in peak times (summer) to reduce the load on the grid by using their generators.

At Bergan and Immanuel almost all of the new construction is patient oriented. At Bergan, the administrative areas were not altered. Midland’s construction consisted mainly of a clinic where all of the lighting is sensored. At Immanuel, the windows have not been replaced, but new fin tube radiant heating has been installed. Immanuel will soon be upgrading the tower windows as a major project, when the funding is available.

### Other New Construction Information

During the renovations, the building envelopes are upgraded by reinsulating from the inside as the interior renovations are done while the exterior remains the same. These upgrades of the envelope needed to meet minimum criteria 2003.

In regards to lighting, the allowances in 2006 were very low, and Alegent is currently in discussion with the state regarding an exemption for patient care. The lighting in patient areas and nurses’ stations is poor and causes difficulty with charting. Regulation agencies for healthcare are often in conflict with energy codes. They are looking into the lighting and HVAC for cycling down to a low level for inactive rooms to reduce energy use.

The public and administrative areas of the facilities include motion detector lighting. All of the facilities use low VOC or no VOC paints.

Nebraska is using 2001 AIA guidelines for healthcare but should be using upgraded 2006 standards.

### Additional Comments

There are competing philosophies and views between what is healing and economic.
Alegent has realized that the engineer needs to come in sooner on projects.

Contracts would need to be rewritten in order to account for sustainable purchases during construction. In addition, contracts need to be rewritten in order to set what is required from outside groups.

Need to budget very early on for major changes.