Leadership in Sustainable Infrastructure
Leadership en Infrastructures Durables

Vancouver, Canada
May 31 – June 3, 2017/ *Mai 31 – Juin 3, 2017*

REGENERATIVE APPROACH TO BUILDING ENERGY RETROFIT PROJECT DEVELOPMENT AND CONSTRUCTION

Safari, Mahsa.[1,5], Riley, David[2], Asadi, Somayeh[3] and Shulock, Lisa[4]
[1,2,3,4] Pennsylvania State University, USA
[5] mbs5586@psu.edu

ABSTRACT: the retrofit of buildings to improve energy performance represents a vast opportunity in the construction market with potential to create jobs, reduce energy demand, and achieve subsequent environmental benefits. Multiple challenges need to be overcome to “unleash” this potential and realize the benefits of investments in improving building energy performance. While large facilities often have easily predictable energy saving potential at scales that are attractive to the financial industry, they are often pursued in a manner that achieves only “low hanging fruit” for short term economic return. As a consequence, they often fall short of their potential to be pursued as an integrative and long term solution. Small and medium sized buildings face even more significant challenges due to the lack of owners’ ability to manage and finance energy efficiency improvements. This research examines a regenerative approach to energy efficiency project development and construction in a regionally focused approach. The use of regenerative business principles, process mapping, and risk analysis to better describe and inform retrofit project investments is presented. Three resulting strategies to reduce risk and advance energy retrofit projects are described.

1 INTRODUCTION

The development of construction projects focused on the upgrades and improvements to buildings for energy efficiency have significant appeal to governments, businesses, energy service providers/utilities, and building owners (Ma et al. 2012; Morrissey et al. 2014). Energy efficiency programs often represent the most significant efforts in sustainability related activities and programs of large facility owners. This interest stems from multiple factors including improved occupant comfort, the resulting savings in energy costs, the potential to deploy new energy efficiency technologies, the introduction of advanced controls, and the shift of buildings from loads on the grid to controllable assets that can contribute to peak load reduction and resiliency. Another enticing feature of building energy retrofits is the fact that construction loans can be secured based on the predicted energy savings of these projects. This fact, coupled with the significant stock of old and new buildings that were built with little regard for energy efficiency, have encouraged efforts to pursue energy retrofit project. Considering the fact that more than half of all commercial buildings in operation today were built before 1970, building retrofitting represent a vast opportunity to improve energy efficiency over the life cycle of the buildings (Safari et al. 2016). The challenge is to unlock this vast potential and realize the benefits of investments in improving energy performance.

1.1 Statement of Purpose

The potential of energy efficiency retrofit projects is significant in terms of health, economic, technical, and environmental concerns but the “activing forces” are often faced with “restraining forces” such as time consuming and cost intensive nature of the work, resource limitations, and uncertainties in project outcomes (figure 1-1). As a result, many Energy Services Company (ESCO) projects focus only on highly profitable projects in large buildings or they only address “low hanging fruit” such as lighting replacement. An effort is needed to find an approach and related strategies that reconcile these forces and enable a vibrant energy retrofit market by actualization all of the full potential of the energy retrofit industry. The goal in this research is to provide a framework that supports the continuous evolution of processes involved in energy retrofit projects with a focus on regenerative business principles and with an intention to minimize investment risks during the project development process. The framework will provide order to energy retrofit thinking, enable more informed decisions about investments, and support the design of value adding processes and tools or trainings to streamline those processes.

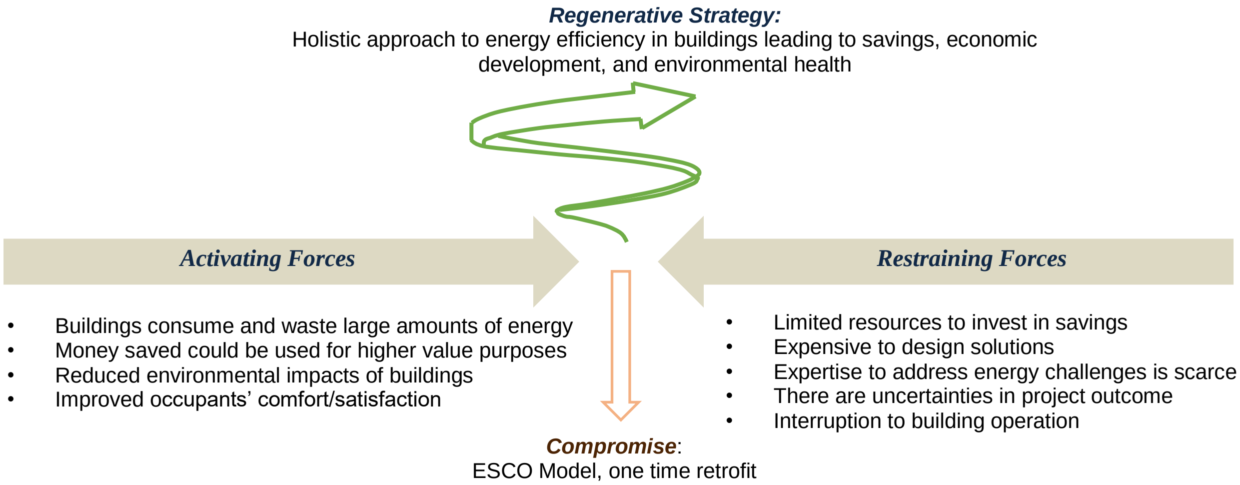

Figure 1-1 Reconciling around potentials, inspired by the law of three framework from Regenesis group

Regenerative Principles and Living Systems Frameworks are used to develop an overall approach to reconcile activating and restraining forces described above. This effort includes the characterization of stakeholders and a value stream map of the energy retrofit processes from initial client engagement through measurement and verification. The result of this effort will enable the identification of discreet investments made throughout the project and the evaluation of these investments in terms of potential value observed by stakeholders. A core concept introduced in the process of energy retrofit project development is the concept of risk management and the evaluation of the value adding processes for proposed improvements and interventions. This will enable the identification of high-risk investments during the process that can be (1) elevated as key decisions that are informed by analysis efforts and (2) potentially improved with interventions designed to lower risk by limiting the capital investment required to pursue these projects. Three proposed interventions are identified to enhance value and reduce investment risks.

1.2 Focus on Convenience Stores and Restaurants

Energy services companies (ESCOs) typically focus on large commercial buildings and industrial facilities because of the economies of scale for both the retrofit construction and the energy savings potential that can be more easily quantified and ultimately because they are appealing to finance through third party investments and require no/low capital investment by the building owner. A drawback of this approach is that most projects tend to focus on “low hanging fruit” such as lighting systems and replacement of aging equipment with more efficient technologies. Small and medium commercial retrofit projects are typically unattractive for the energy retrofit market and traditional ESCO models largely due to the high amount of effort required to develop projects and the small scale of likely return on investment. These small projects are also categorized as a low-margin business, on the order of one percent. The U.S. Environmental Protection Agency (EPA) estimates that achieving $1 in energy savings is equal to increasing sales by $59 (Heads Up: Building Energy Efficiency – Volume 2, Issue 3 (March) 2015). Some of the specific challenges facing small/medium sized buildings have been characterized through interviews with experts in retrofit industry (As a part of some of the government funded initiatives guided by Consortium for Building Energy Innovation (CBEI)):

- Retrofit opportunities are typically in existing and occupied buildings of small businesses that can ill-afford to take the time to explore and implement retrofit projects
- Small business owners are inexperienced with energy use and energy efficiency measures
- A split incentive typically exists between owners of buildings and tenants
- Limited or no capital exists to invest in professional assistance
- There is a limited pool of experienced service providers willing to work on small projects
- Data about energy use and occupancy is difficult to gather
- Uncertainty about energy use creates uncertainty about potential economic return on investment
- Financing small projects is challenging because of the small scale
- Incentives and Rebate programs for small to medium buildings are often prescriptive and use specific audits for specific opportunities rather than integrative approaches.

Despite these challenges, small and medium sized buildings represent a significant part of existing buildings (Navigant Research 2016). Further, many of these small and medium sized buildings have much higher energy costs than larger buildings. For example, convenience stores and restaurants are the most energy intensive type of commercial buildings (3 to 5 times higher than office buildings- see figure 1-2). The challenging aspects of small to medium restaurants and convenience stores, coupled with the significant potential for energy savings in these buildings represents a valuable test market for a new approach that examines a more holistic approach, fully examines the value exchanges required to unleash the potential of these projects, and are thus the focus of this research.

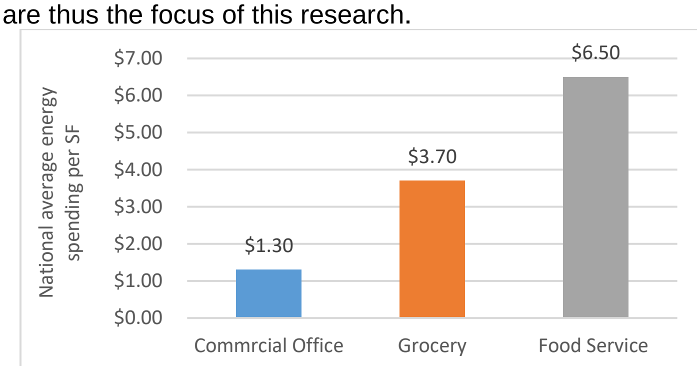

Figure 1-2: National average energy consumption (Energy Information Administration's (EIA) 2003)

2 RESEARCH DESIGN

To inform the framework design, a current initiative supported by the Pennsylvania Department of Environmental Protection (DEP) is examined as context. This initiative is aimed to design and demonstrate a scalable approach to facilitating building energy assessments in small food sales and service businesses in Philadelphia, PA. This project will enable innovative methods to pursue building energy retrofits by converging: (1) low cost energy audits through training program integration; (2) Integrated project delivery of retrofit projects; and (3) energy retrofit financing and assistance strategies such as alignment with new initiatives by the Philadelphia Energy Authority.

(1) Education and training- The Building Retuning Training program (by Consortium for Building Energy Innovation (CBEI)) has been an effective program in educating existing building operations staff about how to reduce energy waste. Penn State researchers at the Navy Yard have been focused on strengthening and growing the building retuning training program as well as looking for new approaches to driving retrofits. The opportunity with this initiative is to use the training curriculum and tools developed for building retuning program to drive both operational improvements and stimulate market demand for energy-saving retrofits in small commercial buildings. The integration of training programs with screening assessments of buildings for retrofit is examined as a strategy to lower customer acquisition costs.

(2) Integrative delivery of energy audits and retrofits- Concurrent with the development and testing of new training and education programs, Penn State has been supporting the development of new energy efficiency project development practices in partnership with National Electrical Contractors Association (NECA)'s Penn-Del-Jersey Chapter. This effort has included the co-creation of new energy efficiency training, the development of a financing instrument called ECAP, and the formation of supply-chain partners. These efforts have evolved into a new model that includes design-build methods and supply-chain integration, and as a result, more holistic and financially viable energy retrofit projects than existing ESCO models. Supply chain integration is a key element of this integrative approach and is pursued by partnering with energy service contractors and electrical contractors conducting energy audits as a design-build team to create retrofit proposals for viable and financeable projects. Through supply chain integration of pricing, proposal development, and financing, retrofit projects can be executed for less cost, and performed in a manner that yields higher levels of savings passed on to building owners than traditionally found in ESCO projects. This innovative process was launched by Private Energy Partners (PEP) and NECA in the Penn-Del-Jersey region in 2015, and has demonstrated promise but is currently limited by the high cost of customer acquisition through initial assessment of buildings and the number of auditors trained to perform assessments.
(3) Energy retrofit financing and assistance- In February 2016, the Philadelphia Energy Authority (PEA) announced a 10 year initiative to dramatically increase investments in building energy efficiency in Philadelphia. The research team is working with PEA on the small commercial sector segment of the initiative, the goal of which is to retrofit 2,500 food sales and services businesses. Small grocery/corner stores and restaurants often pay more for utilities than for rent because of the energy intensity of their businesses. This approach will help thousands of small businesses reduce their overhead and create more stable neighborhood infrastructure that will result in significant energy savings, carbon reduction and economic development.

The research approach examines the flow of an individual project from initial client engagement, through screening assessment, energy-economic analysis and hopefully retrofit and is presented in Figure 2-1. Initially facility owners and tenants will be contacted by EOAC staff as well as through channels enabled by the PEA (Step 1). Owners that agree will be scheduled for a free screening assessment (Step 2) by EOAC trainees and participants (mentored by EOAC staff) who will collect vital data about building conditions, energy use, and capabilities of building tenants/owners to accommodate energy upgrades. Projects with favorable conditions will be scheduled for a detailed audit in which upgrades will be both identified and priced to create a retrofit plan (Step 3). Next, EOAC staff will align projects with the variable types of financial instruments that could support upgrades (Step 4). Once approved, the retrofit will be completed, and long term energy monitoring will be initiated to verify savings and ensure financial objectives and energy savings targets are reached (Step 5).

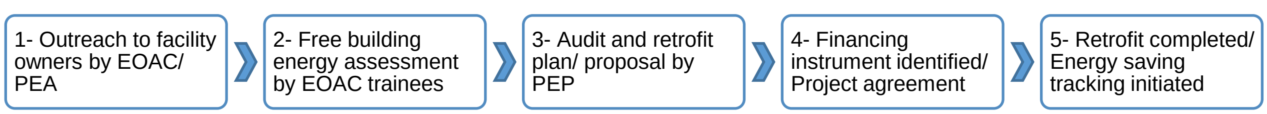

Figure 2-1 Flow of projects from initial outreach to tenants and owners through implementation.

3 FRAMEWORK DESIGN

A framework for the systematic pursuit of energy retrofit projects is proposed to characterize the energy retrofit development process as a series of calculated investments. The goal of the framework is to provide order and organization to thinking during energy retrofit projects and support the continuous evolution of energy retrofit industry. The belief guiding this effort is that a more integrative and holistic approach will yield deeper systems effects and energy efficiency outcomes. The design of this framework is based upon the Regenerative Principles that have been developed through a consortium of thought leaders including the Regenesis Group and the Carol Sanford Institute (Sanford 2016). The principles are intended to help business leaders move beyond paradigms of "doing less harm" or "doing good" to a paradigm that is more reflective of healthy living systems, which are constantly evolving and growing capacity. The seven "First Principles" of Regenerative Business are summarized below:

Wholeness: Viewing organizations and places as living entities that are operating and creating effects in systems. For example, an energy service company is viewed as complete entity with customers, supply chain partners, contractors, investors, etc., and partner in the energy retrofit process as opposed to a provider of one part of the process.

Potential: Focusing on the intention and specific systems effects that can be achieved, rather than existing problems and issues. For example, an overall project goal of unleashing the huge untapped opportunity that exists in retrofitting restaurant and corner stores as opposed to a goal to complete x-number of retrofit projects.

Reciprocity: Operating interactively, with all stakeholders making contributions based on their unique capabilities that create value adding effects and a healthy and vibrant system. An example would be collaboration between an energy service companies that offers business development capabilities to an energy contractor that can provided real-time cost estimating in support of retrofit proposals.

Essence: Knowing that each entity has a non-displaceable uniqueness which comes from their particular location, structure and management philosophy. For example, energy contractors are uniquely positioned for providing construction insight and capabilities, while an energy service company may possess specific engineering skills and entrepreneurial instincts.

Capacity Evolution: Continuously seeking to grow and develop potential in each and all entities, focusing on increasing capacity of a whole to make essence contributions. For an energy service company seeking to add small-medium sized buildings to its portfolio grows market's capacity. This can be done through participation in education and training programs designed to recruit talent to the energy retrofit business community.

Nodes: Recognize intervention points in systems where small actions have big effects. For example, the creation of new entity to facilitate the exchange of high quality information and foster student engagement in the market is anticipated to have a large effect on the systems' health and capacity with a relatively small investment.

Nested Systems: An understanding that all entities are embedded within greater and lesser systems, each playing a core role in the success of the whole and other nested wholes. For example, this research project is in the Philadelphia region, considered as a "proximate whole," but also nested in a bigger system including industry partners and counterparts in the country or the world, namely greater whole.

3.1 Stakeholder Analysis

To discern and organize different players in energy retrofit projects, in this section a framework proposed by Sanford is introduced (Sanford, 2011). Sanford proposes a systemic framework to represent stakeholders as an enabling ecosystem of relationships through which the regenerative business can contribute and receive value. The framework consists of a five pointed star, a pentad of five dynamic and interactive relationships between customers, co-creators of business ventures, earth systems, the proximate community, and investors that a regenerative business manages to produce results (Figure 3-1). A regenerative business is designed to simultaneously serve all of these stakeholders through its way of doing business every day.

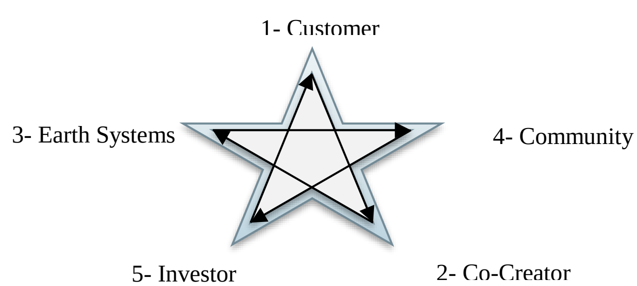

Figure 3-1 Pentad Framework (Sanford, 2011)

In the pentad framework, customer is the first and foundational stakeholder. The second stakeholder, co-creators, refer to the people and organizations who contribute to the creation of a product or service, from raw material suppliers to employees and contractors. The third stakeholder is Earth, the original source and infrastructure without which human activities would be impossible. The fourth stakeholder is community, the human inhabitants of all those places with which a business needs to partner in order to source its materials and workers, manufacture its goods, sell its products or services, and recycle or store its waste. The fifth stakeholder is the investor, without which the company's business would be difficult or impossible to realize. Drawing from this framework, the five stakeholder groups of the building energy retrofit industry are presented in Table 1.

Table-1 Stakeholders of Buildings' Energy Retrofit Industry

Stakeholder	
Customer	Building Owner/ Manager; Occupants/Tenants; Building operators
Co-creators	Energy Service Companies; service providers; contractors; Learning Communities (growing networks of trainers, trainees, and researchers who are interested and work in this area, learning from each other's experience); Supply Chain Partners
Earth Systems	Living systems are often under represented members of stakeholder groups. Including them here allows us to honor the fact that buildings and the environment exchange energy and resources on a daily basis and will allow us to think about the long term sustainability of the whole system.
Investors	Energy investment funds ; Building Owners, Business Development Professionals
Community	Neighborhoods; Utility Companies; Municipalities; Energy Authorities; Association of Specialty Organizations/Businesses; Community Economic Development Associations

To enable optimal contributions of these stakeholders, the formation of an Energy Outreach and Assessment Center (EOAC) is proposed to serve as a coordinating body across the research, education, outreach, and business transactions that make up the proposed framework.

3.2 Design new entity to foster regenerative approach and evolve capacity in region

A new entity was envisioned to enable proposed strategies to be pursued. The EOAC is utilizing PSU facilities to house training and management functions of the pilot as well as incubation space for the collaborating team members. EOAC management philosophy was defined and articulated as follows:
Core Function: To develop CAPACITY in beneficiaries of buildings' energy retrofit
Core Process: To reveal and facilitate reciprocal value exchange between stakeholders
Core Value: VITALITY, VIABILITY AND EVOLUTION of building energy retrofit industry

3.3 Mapping wholes and reciprocity

In the context of DEP project, retrofit activities are mapped to define regional stakeholders and to investigate value creation and exchanges in networks of stakeholders, see Figure 3-2. This will help in defining the contribution of EOAC in the system.

3.3.1 Proximate whole

The Philadelphia location for this pilot will enable innovative contributions by multiple partners who are concurrently developing new methods for building energy efficiency through job-creating retrofit projects. These partners include the Philadelphia Energy Authority (PEA) and its Energy Campaign with backing of Philadelphia City Council President Clarke and Mayor Kenney. PEA is embarking on an ambitious campaign to dramatically reduce building energy use in Philadelphia over 10 years. PEA brings a city-wide initiative with a team devoted to outreach and recruitment of convenience stores and restaurants with the effort nested in a larger initiative with dozens of stakeholders and touching tens of thousands of city-owned buildings, schools, and public and private residences. PEA and Pennsylvania State University (PSU) are seeking to test and demonstrate a model through this project which will ultimately result in the retrofit of 2,500 small businesses in Philadelphia. To pursue this ambitious effort, PSU created a new entity (Energy Outreach and Assessment Center or "EOAC") to steward capacity building in the region with an intention to disseminate the model to other cities in Pennsylvania. The combination of PSU training and PEA's access to facilities is the cornerstone of the first innovation noted above, namely "lowering the cost of energy retrofit customer acquisition."

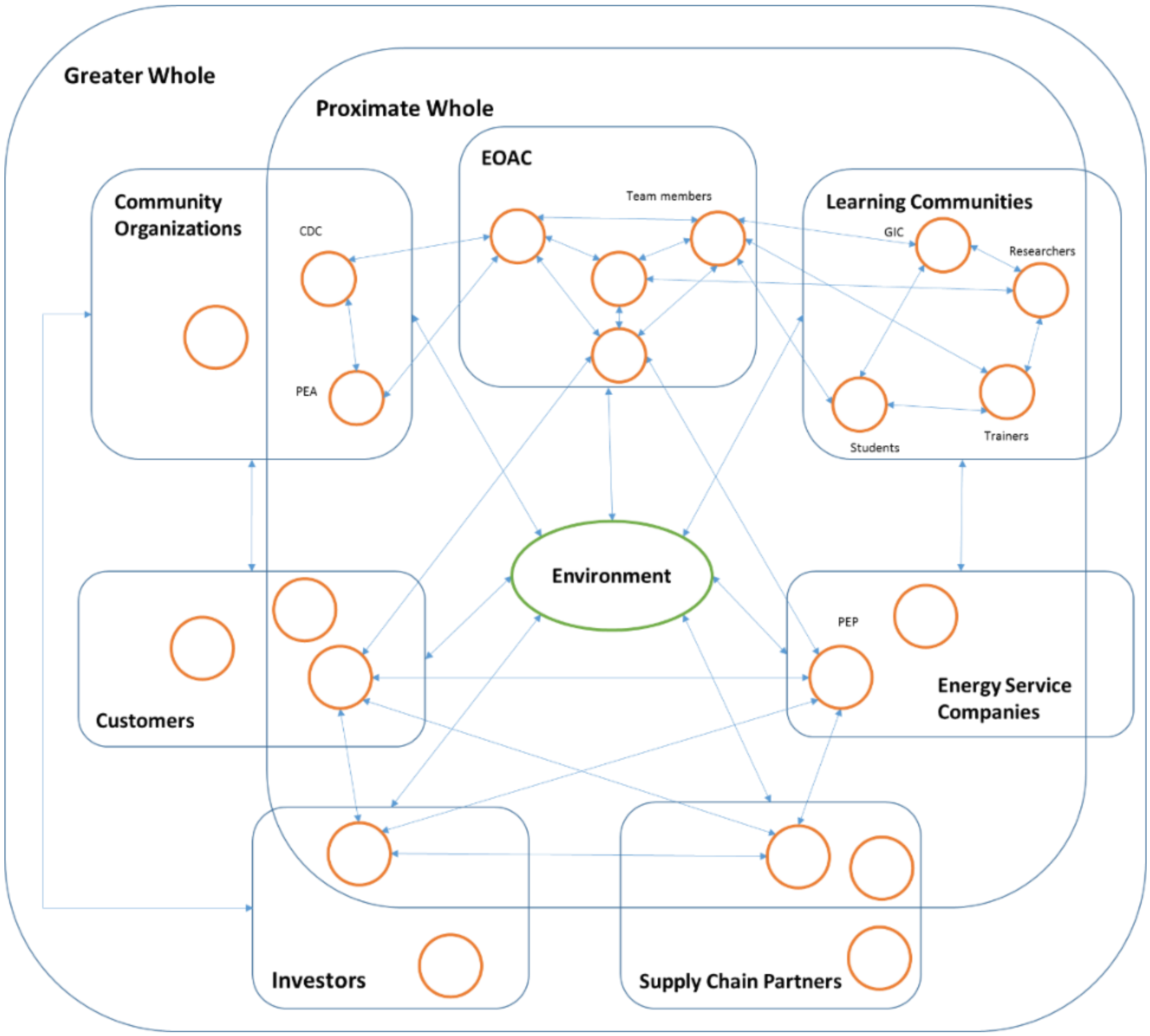

Figure 3-2 A concept map to illustrate value exchange between stakeholders of energy retrofit industry

3.4 Revealing Value & Potential: Process Mapping

A granular description of the whole energy retrofit process is needed in order to study, evaluate, and improve building energy retrofit industry. Process maps have been used frequently to illustrate the chronological sequence of activities in a business process. Process maps help identify the inefficiencies and the non-value adding activities that may exist, enabling everyone involved with improving the process to agree on the most efficient steps and routes for improvement or re-engineering (Saadeddin 2016). The framework is designed in a way that the following principles are met:

- Identify high impact activities
- Identify value adding processes
- Identify key decisions about investments during processes
- Be organized in a way that maintains value flow

To graphically represent the processes involved in a retrofit project, the language constructs of Business Process Modeling Notation (BPMN) has been used. The main attributes of this framework (Figure 3-3) are: (1) Different investment levels are defined to ensure that each set of activities will result in predefined value; (2) Key investment decisions are highlighted in the process to allow for application of risk management techniques; (3) the further a project goes along the process flow, the more value will be exchanged between different stakeholders. Four different value streams (presented in Table-1) is considered to reflect different levels of investment and expected outcomes for any energy efficiency effort.

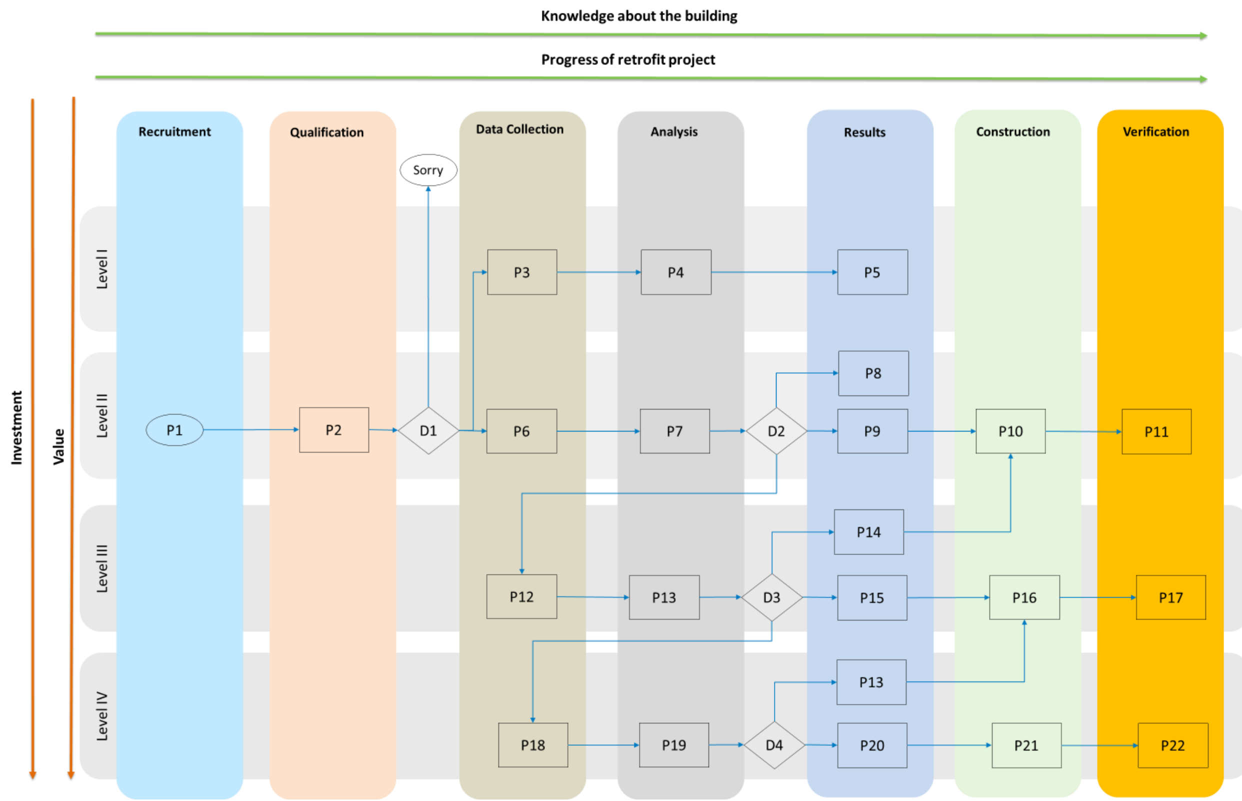

Figure 3-3 Proposed framework for pursuing retrofit projects

The element sets that were used in this diagram are presented in Figure 3-4. Flow Objects are events, activities and gateways. Events are either start events, intermediate events or end events. Activities are divided into process, sub-process and tasks and denote the work that is done throughout a retrofit project. Gateways are decision points and are used for determining branching, forking, merging or joining of paths within the process. Sequence Flow defines the execution order of the activities within a process. Swimlanes act as a graphical container for a set of activities taking place in each project phase or investment level.

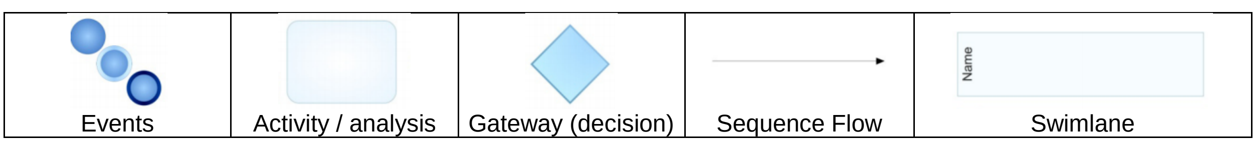

Figure 3-4 Elements of Business Process Modeling Notation (BPMN)

Table-1 Value Streams

Effort Level	Short Description	Investment Level	Input	Outcome
Level I	Benchmarking	Very Low	- Utility Data	- Benchmark - Increasing Awareness
Level II	Green Impact	Low	- Short building survey	- Low/No Cost EEMs - Increasing Awareness
Level III	Building Retuning	Medium	- Utility Data - More detailed building survey - Meeting decision maker	- Low/No Cost EEMs - Introducing Available Grants - Increasing Awareness - Education and Training
Level IV	Deep Retrofit	High	- Utility Data - Complete building survey - Instrumentation - Meeting decision maker	- Maximum Saving - Business actualization

In the proposed framework, decisions are made sequentially and the investment level will be adjusted with the acquisition of new information. Figure 3-5 presents the organization of decision making process for further investment in a project. New information might lead to departing from the investment scenario that was originally planned; acceleration or deceleration of investment rate, or simply abandoning the program in midstream. After studying many retrofit projects, reviewing industry practices and scholarly literature four decision points (Table-2) were defined in the proposed framework.

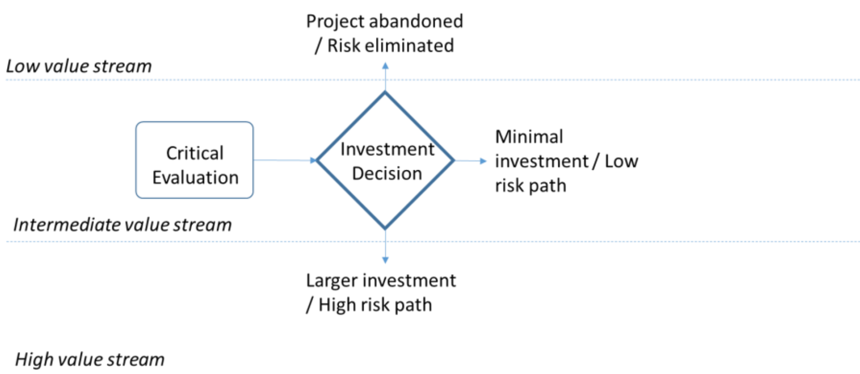

Figure 3-5 Decision points organization

Table-2 Key Investment Decisions

Process ID	Short Description	Criteria/ Questions The more criteria fulfilled the more favorable the result will be	Level of uncertainties
D1	Fit for Assessment?	- In-operation Less than 6months? - Outside Service Area? - Not Food Service? - National Chain? - Have Utility Data?	Very high
D2	Retrofit Potential?	- Building has high saving potential? - Owner has high will to retrofit?	High
D3	Fit for Retrofit?	- Have walk-in refrigeration units? - Have linear fluorescent fixtures installed and not LEDs? - Have old HVAC equipment (>20 years or beyond end of life)? - Owner is interested in a retrofit proposal?	Medium
D4	Fit for Financing?	-Financial and technical proposal satisfy investors risk threshold?	Low

As mentioned earlier, the pursuit of an energy retrofit project requires a series of investments in business development (cultivation of client) and data acquisition about physical conditions. Decisions to proceed with subsequent steps require an evaluation of the feasibility of the retrofit project and the risk of proceeding. In the next chapter, a risk management technique will be introduced and deployed to investment decisions of buildings' energy retrofit.

3.5 Evaluate Potential: Risk Management

Risks create uncertainty about the outcomes of building energy retrofit projects. At the same time, organizations deliberately invest in marketplace or commercial risks when there is an opportunity to achieve a positive return. There are risks/dangers associated with taking an opportunity, but there are also risks associated with not taking the opportunity. The Institute of Internal Auditors (IIA) defines risk as the uncertainty of an event occurring that could have an impact on the achievement of objectives. The IIA adds that risk is measured in terms of consequences and likelihood (Hopkin 2012).
An integrated approach to identification, analysis, evaluation, and treatment of these risks, referred as risk management in literature, is needed to:

- Reduce the variance between anticipated outcomes and actual results.

- Ensure that correct business decisions are taken.
- Assist with efficiency of operations, effectiveness of processes and efficacy of strategy to ensure the best outcome with reduced volatility of results.
- Ensure compliance with legal and regulatory obligations of each project

3.5.1. A simple model for evaluating investment risk

In this model, energy service companies make a series of expenditures sequentially that become productive only after the entire sequence is completed. For example, to actualize a retrofit project, a total outlay of $X is required over different phases of delivery process and as established in the market a profit margin of y% is expected after completion of the project. Evaluating the project requires a decision support system that determines whether additional investments should be made over the cumulative amount that has already been spent. That decision will depend on the present value of completed project, the remaining investment needed for completion, and the risk and opportunity cost of abandoning or pursuing project completion. Given the following values for investment in each stage and probability of achieving the expected outcomes, the present value of investment, denoted by V, can be calculated at any time period.

No	Project Stage	Required Investment	Distribution of Profitable Projects (P_i)	Expected Profit Margin (%)
1	Recruitment	$a_1 \times X$	1 in 100 candidates (1%)	$y \pm D_1$
2	Qualification	$a_2 \times X$	5 in 100 candidates (5%)	$y \pm D_2$
3	Data Collection	$a_3 \times X$	10 in 100 candidates (10%)	$y \pm D_3$
4	Analysis	$a_4 \times X$	15 in 100 candidates (15%)	$y \pm D_4$
5	Communicating the Results	$a_5 \times X$	20 in 100 candidates (20%)	$y \pm D_5$
6	Construction	$a_6 \times X$	80 in 100 candidates (80%)	$y \pm D_6$
7	Verification	$a_7 \times X$	95 in 100 candidates (95%)	$y \pm D_7$

The present value will fluctuate over time, reflecting uncertainties about project outcomes and is given by:

$$V_i = \text{Expected Outcome} - \text{ Investment} = P_i \times X \times (y \pm \Delta_i)\% - (1 - P_i) \times \sum_{i=0}^{7} a_i \times X$$

Go/No-Go decision on investing more in a retrofit project depends on the present value of the investment and also the risk tolerance attitude of decision makers. Risk management strategies can be applied to increase the probability of a successful project for all involved beneficiaries.

3.5.2 Strategies to Manage Risk: Design of Nodal Interventions

The characterization of the energy retrofit ecosystem enables the identification and evaluation of strategies to intervene in the process with the goal of making overall positive system effects. Specifically, strategies that reduce investment costs and process waste can be examined to increase the present value of investments. To date, the following strategies have been proposed and are being tested in the context of DEP project:

Reveal Key Decision Points: Probability of project viability can be increased by designing decision points in the process at critical stages of project to avoid high risk investments.

Targeted data collection: Uncertainty about project outcomes can be minimized by asking right questions at the right time in the process

Reduce Investment / Risk: Project cost can be minimized by three following interventions in the delivery process:

- Minimizing energy audit cost by engaging trained students and entry level auditors
- Supporting documentation process by providing data collection and report/proposal writing tools (automation and information technology)
- Integration of instrumentation phase with verification phase to justify the cost of additional data collection, if needed

4 CONCLUSIONS

This research represents an effort to pursue a regenerative approach to the delivery of building energy retrofit projects. An assessment of the various organizations as wholes is used to reveal systems contributions and reciprocal value exchange. In doing so, unique opportunities for organizations and individuals to make essence contributions are identified and cultivated. Process mapping and the definition of value streams reveal opportunities to organize pursuit of projects as a series of calculated investments to pursue projects based on an evaluation of the potential for a return on investment. The present value of investment at any time period can dictate the navigation between different value streams. The evaluation of strategies to reduce the level of investment required to develop retrofit projects is also enabled by this approach. Strategies with high potential to yield systems effects include: (1) the integration of education and training programs that engage students in the performance of screening assessment, (2) investments in integrative delivery methods and information systems for retrofit projects, and (3) will provide an opportunity to train college students and community members in building energy assessment methods. Future research in energy retrofit project business development and retrofit project evaluation will build on this framework by advancing quantitative methods for the evaluation of business development investments this important sector of the construction industry.

REFERENCES

Heads Up: Building Energy Efficiency – Volume 2, Issue 3 (March) 2015. http://www.nrcan.gc.ca/node/17356, accessed February 16, 2017.

Hopkin, Paul 2012 Fundamentals of Risk Management : Understanding, Evaluating and Implementing Effective Risk Management (2). London, GB: Kogan Page. http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10555723, accessed January 24, 2017.

Ma, Zhenjun, Paul Cooper, Daniel Daly, and Laia Ledo 2012 Existing Building Retrofits: Methodology and State-of-the-Art. Energy and Buildings 55. Cool Roofs, Cool Pavements, Cool Cities, and Cool World: 889–902.

Morrissey, John, Niall Dunphy, and Rosemarie MacSweeney 2014 Energy Efficiency in Commercial Buildings: Capturing Added-Value of Retrofit. Journal of Property Investment & Finance 32(4): 414–396.

Navigant Research, 2016 Energy Efficiency Retrofits for Small and Medium Commercial Buildings.
https://www.navigantresearch.com/research/energy-efficiency-retrofits-for-small-and-medium-commercial-buildings, accessed February 16, 2017.

Saadeddin, Daoud 2016Process Mapping | Continuous Improvement Toolkit. http://citoolkit.com/articles/process-mapping/, accessed January 29, 2017.

Safari, Mahsa, David Riley, Somayeh Asadi, Parhum Delgoshaei, and Lisa Shulock 2016 Building Energy Efficiency through Engaged Scholarship. In Construction Research Congress 2016. http://ascelibrary.org/doi/abs/10.1061/9780784479827.001, accessed February 11, 2017.

Sanford, C. 2011, The Responsible Business: Reimagining Sustainability And Success, Jossey-Bass Publication.

Sanford, Carol 2016 Blog title: What Is Regeneration? Regenerative Business Summit. http://theregenerativebusinesssummit.com/regeneration/, accessed February 15, 2017.