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Innovation in accelerating sustainable technology – Bio-energy Research Demonstration Facility Case Study

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Abstract: Sustainable technology innovations are created each year, but without being tested at a scale that is useful for demonstration and eventual replication, some are not advancing as quickly as they could. The "Campus as a Living Lab" concept at The University of British Columbia is being used as a means to not only accelerate the adoption of new technology, but to inform decisions regarding sustainable infrastructure development. Projects completed within the first five years of the program are estimated to reduce campus natural gas, energy and greenhouse gas emissions by 9%, 22%, and 33% respectively. (UBC, 2011) (UBC, 2012). The aim of this paper is to demonstrate how the formalization and modeling of a living lab program model (including business process models) could lead post-secondary institutions, municipalities and other for-profit and non-for-profit organizations to reductions in energy consumption and GHG emissions. To illustrate this approach, this paper presents business process models that describe how the living lab program was implemented in the case of UBC's Bio-energy Research and Demonstration Facility, one of the initial and most successful CLL projects undertaken by UBC.

1. Introduction

As municipalities, universities and the like strive to meet the operational goals for their facilities, some may identify success as "meeting operational requirements within a balanced budget". Others aim further by attempting to incorporate longer-term strategic objectives within their more immediate operational and budgetary needs. The University of British Columbia (UBC) is pursuing the synergistic integration of the campus's operational activities, long-term sustainability targets, and research initiatives. This is the essence of UBC's *Campus as a Living Lab (CLL)* program that creates industry and community partnerships in order to test state-of-the-art sustainable technologies, systems and processes, at-scale that is useful for transfer, adoption, replication and commercialization efforts.

This paper presents research that examines UBC's CLL program; recording the events and formalizing the methods using *business process modelling (BPM)* in order to clarify, evaluate, and communicate the CLL processes. The models presented here include an *overview of unsolicited requests for capital projects, current practice for unsolicited project plan submissions greater than $1.5 million,* and an *example project plan submission from the Bioenergy Research and Demonstration Facility.*

The research methodology has involved investigating the context and origins of the CLL program through interviews and review of relevant documents, collecting information about the current operations of the program through various information sources including participation in some of the relevant processes, and examining the processes followed on specific CLL projects carried out to date. Simultaneously, business process modeling (BPM) methods where identified to describe, formalize, and analyze the CLL processes. From a wide variety of BPM techniques reviewed, workflow diagrams was chosen and, as an initial focus, applied to the Bio-energy Research and Demonstration Facility. The Bio-energy Research and Demonstration Facility project represents a unique opportunity to apply the proposed modelling methodology, as it was initiated before the CLL processes had been formally established. This provides insight into the challenges that institutions faced in trying to incorporate sustainability objectives into operational planning, as well as the solutions developed to overcome them. The work presented in this paper represents the beginnings of a roadmap for leveraging institutional operations to help drive systemic change towards more sustainable technologies and practices.

2. Background of the Campus as a Living Laboratory Program

The processes presented in this paper focus on the Bio-energy Research and Demonstration Facility, which is a signature CLL project, but is just one of many projects that have been undertaken within the CLL program. $150 million in capital projects has been approved to date: $75 million in projects already completed and another $75 million in projects underway. The Bio-energy Research and Demonstration Facility represents a $27 million investment (UBC, 2012b). A significant amount of work was required to reach this point.

Although UBC started on the sustainability path in 1997, its sustainability activities accelerated in 2007 when UBC became "one of six founding signatories to the University and College Presidents' Climate Statement of Action for Canada" (UBC, 2010a). Following this, the university's 2009 "Sustainability Academic Strategy" recommended the creation of a *University Sustainability Initiative (USI) to integrate campus-wide academic and operational sustainability efforts*, including the creation of the CLL program (UBC, 2009). After the establishment of these initiatives in March of 2010, UBC adopted a climate action plan that committed to aggressive sustainability goals, including the goal to have zero greenhouse gas (GHG) emissions by 2050 (UBC, 2010b).

Conversations regarding a Bioenergy Research and Demonstration Facility had begun in 2008 between UBC's Clean Energy Research Center and Nexterra Corporation, with a decision to proceed with the project in 2009 (UBC, 2010c).

As the CLL continues to evolve to support UBC's aggressive sustainability targets, its processes also continue to emerge and be refined. By attempting to identify and record these processes at this time using BPM, this research aims to provide value by: 1) Clarifying the processes to make it easier for all to understand and follow these processes, 2) creating opportunities to review, evaluate, refine, and potentially improve the CLL processes, and 3) facilitate the adoption of a CLL program model by other institutions. This third objective is based on the premise that the CLL program adds value towards achieving long-term societal sustainability objectives, and that this value could be extended if it were adopted by other universities, municipalities, etc. Other universities and municipalities share at least one of the keys to success of UBCs CLL program: they are owner-operated. This is crucial as it provides control over long-term decision-making about their infrastructure. Other keys to success that are helping UBC to achieve its goals are the following: 1) a strong champion has led the process, 2) there is strong support from the top, 3) key decision-makers and on-the-ground workers are integrated in the process, 4) UBC has a long-term sustainability vision, and 5) the risk is tolerable. Although universities may be more risk-tolerant, municipalities and other institutions may be able to accept some degree of risk in ventures that can help them to achieve their own sustainability targets.

3. Introduction to Business Process Modelling

Primary references for the selection of a business process models (BPMs) were the work of Lou & Tung (1999) for determining the objectives and characteristics the model should possess, Cutis et al. (1992) for integrating perspectives, and Giagalis, G.M. (2001) for reviewing the types of BPMs. After these frameworks, among others, were reviewed, the existing BPM methods of the CLL were considered and workflow diagrams were chosen as the method of illustration for two reasons: 1) some workflow diagrams had already been created for CLL processes by Brent Sauder of the UBC Strategic Partnerships office, and 2) they provide a clear organizational view as well as highlight the points of decision-making and document creation.

BPMs have been widely used in the technology sector to help plan solutions for optimization of processes via visualization. There are a plethora of models to choose from. To illustrate this consider that by 1997, it was determined that there had been 72 different modeling methodologies produced (Kettinger, Teng, & Guha, 1997). There are various approaches to selecting the type of model to use. The three main points of reference are objectives, perspectives, and characteristics. Objectives determine the overall function of the model, which can vary in granularity from simply being able to "communicate" to "analyse" or even "control" a process (Luo & Tung, 1999). Perspectives view the information from "what processes are performed", "when processes are performed", "where and by whom in the organization" the processes are performed, and what information is "produced or manipulated by a process" (Curtis, Kellner, & Over, 1992). Characteristics review the ease of use, enactability, the ability to support automated process manipulation, scalability, and formality (Luo & Tung, 1999). Given these points of reference, the work of Giagalis was used to review 13 model types before deciding upon workflow diagrams (flowcharts) for their ability to produce models to easily understand, communicate, improve, and manage processes. (Giaglis, 2001)

In reference to objectives, perspectives and characteristics, the model can communicate and analyse processes while providing information on what processes are performed and in which sequence. Given the addition of swim lanes, the models are also able to identify which groups undertake the work. The positive characteristics are their ease of use and not overly taxing formality. The models are also scalable, but many BPMs must be used to gain the overall picture as a single model of the entire CLL program would be simply too large to view in its entirety at one time. Thankfully, models can be collated so that one can drill down on specific processes as can be seen with the example with Figure 1 and Figure 2.

4. Models of Processes

The modelling of the processes follows a standard work flow diagram. Each shape is listed in a legend on figure 1 and is further detailed here:

Swim lanes: The horizontal rows where shapes reside to illustrate who creates the item or is responsible for carrying out the process (i.e., the participants).

Process: Work to be undertaken at key points.

Subprocess: Minor work to be undertaken.

Start/End: Where the process starts or ends.

Document: Documents used as inputs or created as outputs of processes.

Data: Data exchange between parties.

The BPMs presented model the *overall view of Unsolicited Requests for Project Plan Submissions* (Figure 1), *Unsolicited Project Plan Submissions Greater than $1.5 Million – Current Practice* (Figure 2) and the *Project Plan Submission – Bio-energy Research and Demonstration Facility Example* (Figure 3). Providing these models provides a demonstration of how these models can create a hierarchical flow and

illustrates the improvements that the CLL has contributed. To better understand the models, brief descriptions of the swim lane headings (participants) are below.

Administration: Vice presidents of the university.

CLL Steering Committee: A robust group of people from campus operations, the USI, the Strategic Partnerships Office, Campus and Community Planning, deans, UBC VP Finance, a representative from the UBC Okanagan campus, and the University Neighborhood Association. There are 26 people on this committee.

CLL Working Group: A diverse group of people from campus operations, the USI, and the Strategic Partnerships Office. This group reports to the CLL Steering Committee and has many of the same members. There are 24 people on this committee.

Company or NGO: The company or non-governmental organization submitting the proposal.

Faculty / Research: The faculty or research member involved.

Institutional Project Approval: In UBC's case, this is the Board of Governors.

Nexterra: Company contracted to implement the Bioenergy Research and Demonstration Facility

Other: An extra swim lane for items without a representative home.

Strategic Partnerships Office: The office involved with cultivating industry partnerships.

Details on these three models are listed below.

4.1 Overall View for Unsolicited Requests for Capital Projects (Figure 1)

While UBC has a formal process for CLL requests for proposals, for strategic sustainability reasons and in accordance to its innovative CLL approach, UBC also entertains unsolicited proposals. These however are subject to a screening procedure that is as rigorous as the formal request for proposals process. Figure 1 provides an example of how these models can create a hierarchical flow. Each model is numbered so as to correspond to another layer in the model. In Figure 1, the process for "Capital Project > $1.5M" is labelled "P - 1.9.2.3" and the corresponding layer for this is presented in Figure 2. As this interaction demonstrates, it is possible to have many layers to the processes involved.

4.2 Unsolicited Project Plan Submissions Greater than $1.5 Million – Current Practice (Figure 2)

Unsolicited project plans are categorized into two areas; those greater than $1.5 million, and those less than $1.5 million. The first stage of either unsolicited request requires completing an online form and submitting a two page proposal. This first step is crucial in ensuring that UBC's interests align from the beginning of the project and it has been tailored to ensure that information gathered addresses specific questions. From here, the proposal is reviewed by the Strategic Partnerships Office who provides feedback to the CLL working group for review. This is an important step to have as these reviews are carefully done by a diverse team of individuals who contribute various areas of campus expertise and involves examining the four cornerstones of CLL projects:

1. *"The integration of UBC's core academic mandate (research and teaching) with the University's operations*
2. *Partnerships between the University and private sector, public sector or NGO organizations*
3. *Sound financial use of UBC's resources and infrastructure*
4. *The potential to transfer the knowledge UBC gains into practical, positive action applicable to the greater community"* (UBC, n.d.)

If the working group considers the project to have potential, then the Strategic Partnerships Office will pursue the company for additional information to further review with the CLL working group. If the CLL working group agrees that there is a fit, then a champion for the project is identified. (Appointing a champion for a project can prove challenging at times when everyone already is balancing a full-time workload.) Once a project champion has been appointed, then a presentation is made to the CLL Steering Committee for final vetting before a memorandum of understanding is created. The CLL Steering Committee consists of a robust group of individuals from various areas and levels of authority that provide another thorough review of the project. If UBC funding is required, then a business case would also be created for institutional project approval. For UBC, this body is the Board of Governors. In the case of the Bioenergy Research and Demonstration Facility, UBC capped its capital investment at $5.5 million. (UBC, 2010d)

4.3 Project Plan Submission - Bio-energy Research and Demonstration Facility Example (Figure 3)

UBC embarked an unsolicited partnership with Nexterra Power Systems and other partners to build a Bio-energy Research and Demonstration Facility. Given that processes had not been established yet for the CLL, the Bioenergy Research and Demonstration Facility represents a unique learning experience.

Before discussing Figure 3, it is helpful to address some of the components of Figure 2. The areas highlighted in grey represent practices that were not implemented for the Bioenergy Research and Demonstration Facility. Items that are not highlighted and are not in the Institutional Project Approval swim lane were implemented by a different unit or person. When comparing Figure 2 and Figure 3, it is obvious that the project plan submitted for the Bio-energy Research and Demonstration Facility does not contain many of the checks and balances that the current process for *Unsolicited Project Plan Submissions Greater than $1.5 Million* has. The key areas that are missing include the process for a company to initiate contact, the subsequent reviews and the identification of a research and operational champion from within the university. Furthermore, when viewing Figure 3, it also becomes quickly apparent that the process is less robust and that there were less people involved.

5. Case Study and Application of Model

Although the Bioenergy Research and Demonstration Facility was a success in the end, there are many lessons to be learned from this process through the application of the models presented. If Figure 3 had been presented to key people who should have been included in the process earlier on, it could have been quickly realized that more checks and balances were required. After the project began construction, a thorough review was completed in February of 2011 of the process involved and many items emerged from this, including learning that certain people needed to be involved earlier.

This process resulted in a review of the CLL process which resulted in the addition of key organizations and individual experts to the CLL Working Group and Steering Committee. Part of this involvement includes having a seat on the CLL Steering Committee for the University Neighborhood Association, BC Hydro and others. Since the transition to an improved system, workflow models have been shared with others in the group to review the processes in place and to improve upon them. BPMs are easy to follow and useful for diffusing and disseminating results and capturing lessons learned to aid with improved sustainability and better coordinated processes.

6. Summary and Conclusions

The use of BPM is to not only analyze current processes, but to also assist with knowledge transfer by creating a roadmap for high performance sustainability. A workflow model was chosen as it can achieve both of these while being able to be used to easily understand, communicate, improve, and manage processes (Giaglis, 2001). The Bio-energy Research and Demonstration Facility example illustrates how projects may forgo key stages such as thorough reviews if everyone who should be involved does not have a clear view of the process. The BPMs in this paper show how the information can be easily reviewed by others to aid in improving processes for the future.

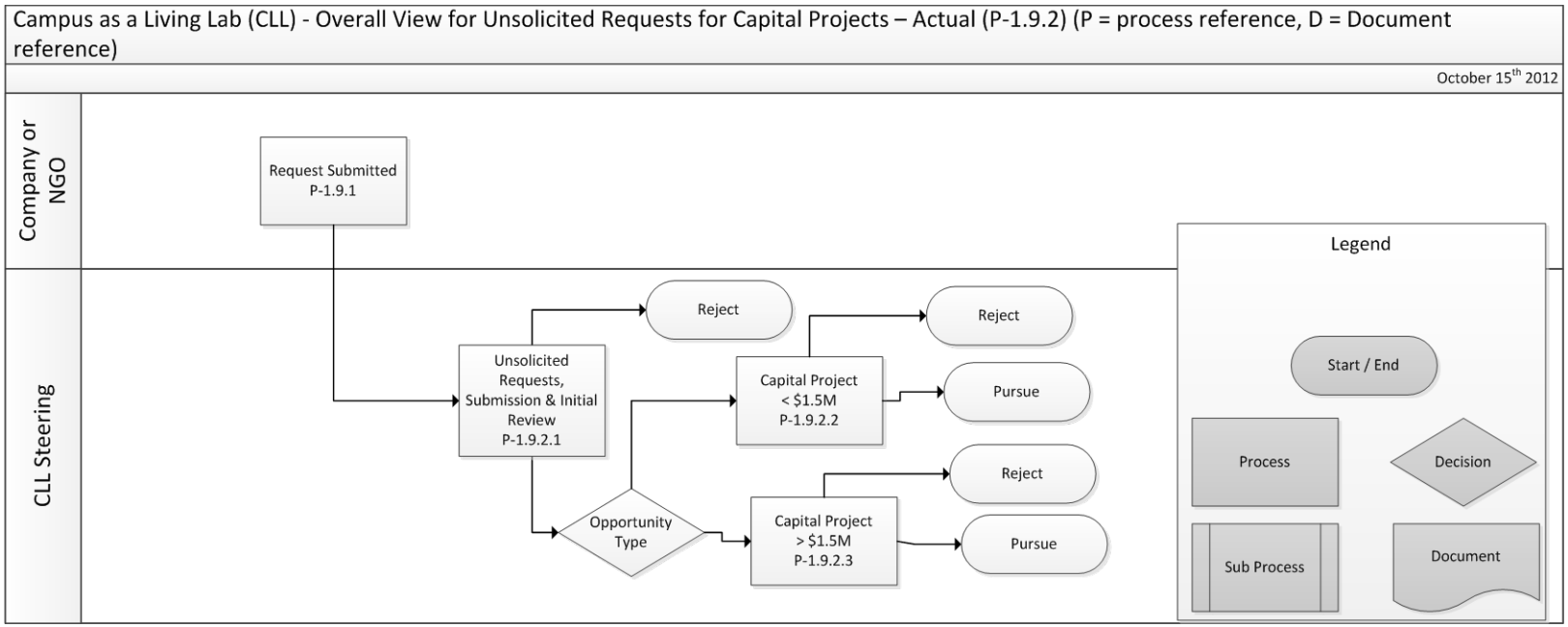

Figure 1: Campus as a Living Lab (CLL) – Overall View for Unsolicited Requests for Capital Projects - Actual

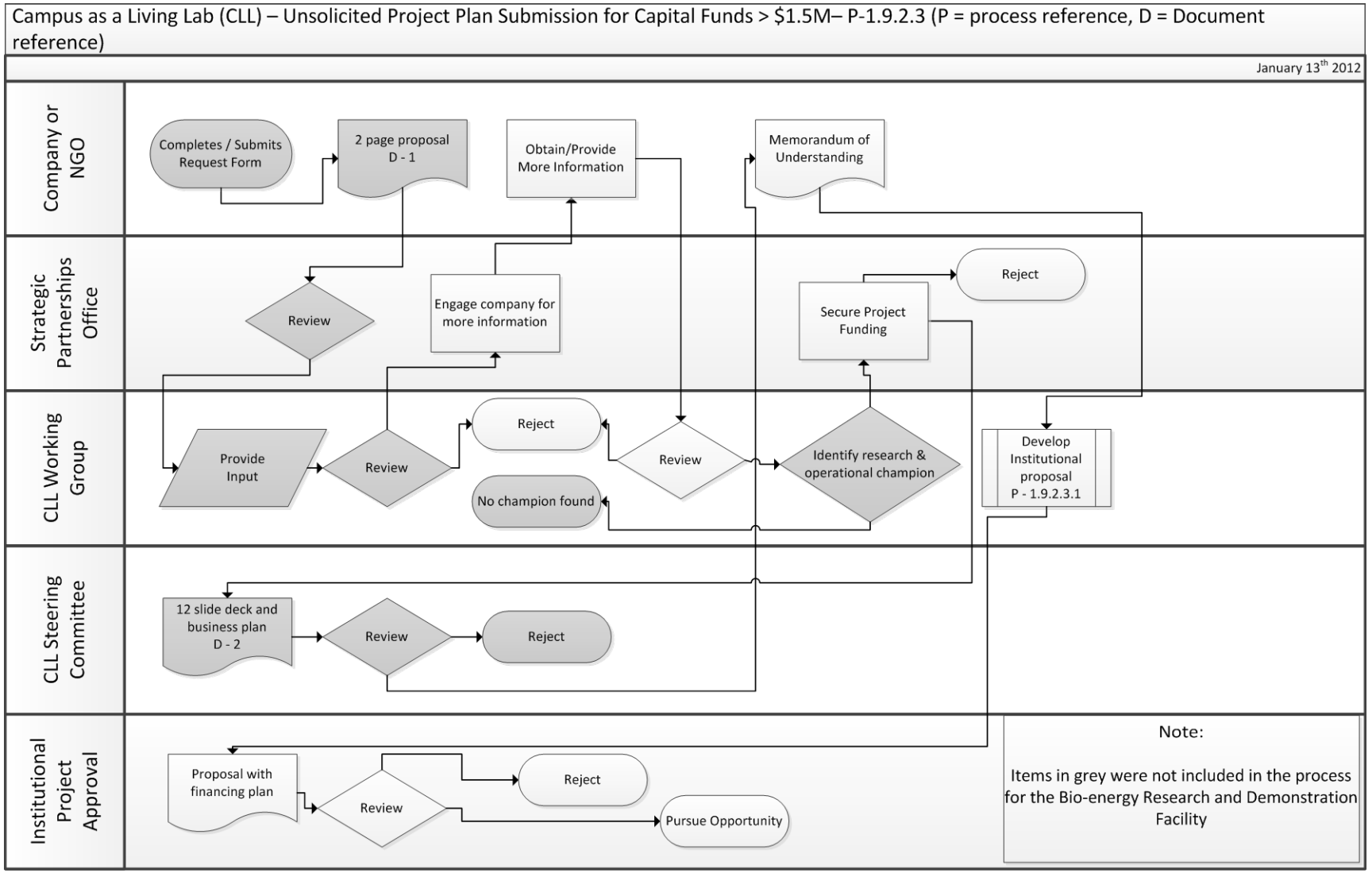

Figure 2: Campus as a Living Lab (CLL) – Unsolicited Project Plan Submission for Capital Projects Greater than $1.5M

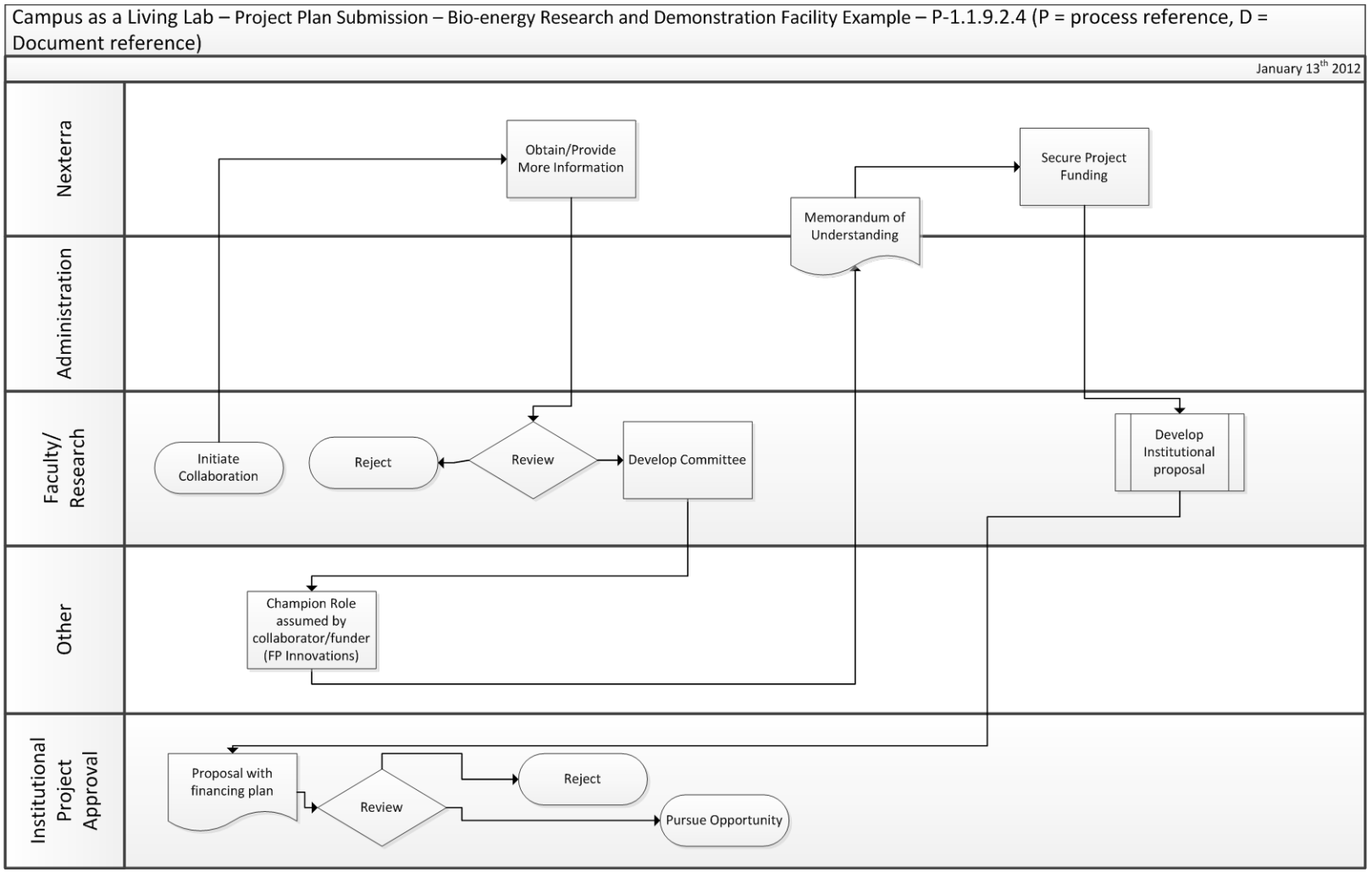

Figure 3: Campus as a Living Lab – Project Plan Submission – Bio-energy Research and Demonstration Facility Example

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