[O7.16]

Learning the lessons from a regional industrial energy efficiency initiative

R. Allarton*[1], G. Locatelli[2]
[1]*University of Lincoln, UK,* [2]*University of Leeds, UK*

Abstract

Industry accounts for 29% of UK energy use, placing energy efficiency in this sector as a fundamental to sustainable development. Given that 99% of UK industrial companies are Small and Medium Enterprises (SME) supportive initiatives in this area have the potential for significant savings and impact.

This paper present a deep reflection of a local government project called "SUSTAIN Lincolnshire – Phase 2" to improve the energy efficiency of industrial SMEs within its region. A critical analysis will centre on the problems of co-ordinating and encouraging a large number of SME to become pro-active in this area. This starts with the importance of clearly defined and understood requirements, through engagement and activities with SME, to achievements attainable beyond the project.

Currently, many Councils, leasing with universities, have numerous initiatives, similar in style to the project considered. The critical analysis in this paper will allow those project initiators and stakeholders to take advantage of the lessons learned when developing similar projects.

Introduction

SMEs form over 90% of UK industries [1], but generally, they lag behind larger companies in their organisational and operational efficiency savings. SMEs do not have the resources to dedicate to efficiency identification and implementation. Concepts such as Lean or Agile Engineering require wholesale change and investment, which is not practical for smaller firms. Implementation strategies in large companies are achievable because they can enforce change within the company bounds. These changes can extend in to the supply chains through mandate, but can also be enforced between departments within a large company, ensuring the efficiency of both inter-action and intra-action is maximised. Such organisational directive and focus that exists within a large company is not replicated within SMEs, or in the inter-actions between SMEs.

Lincolnshire County Council, supported by the East Midlands Development Agency and European Regional Development Fund, promoted a series of activities under the project name of SUSTAIN Lincolnshire. In Phase 1, the project had these key goals[2]:

- Help Lincolnshire's business to become more competitive,
- Reduce their carbon footprints and safeguard the environment.

Phase 2 built on this, focusing on the Engineering and Food production activities of the region. The Council achieved this by engaging the University to provide strategies and actions to support these two key regional industrial sectors. This paper is a deep reflection on the Engineering aspect of the SUSTAIN Lincolnshire Phase 2, presenting key insights in to:

- Organisational strategies for industrial SME support.
- Practical support of individual companies
- Practical support for company collaboration
- Encouraging a sustainable approach to energy

This short-paper is structured as follows:

The SUSTAIN Lincolnshire Phase 2 Engineering Project

1.1 Project Objectives

The SUSTAIN Lincolnshire Phase 2 Engineering Project (herein SUSTAIN Lincolnshire) was a 24 month collaborative partnership between Lincolnshire County Council and the University of Lincoln to provide energy efficiency support to county SMEs. The Circular Economy[3] was identified as a guiding principle to achieve sustainable SME growth, strengthen the industry sector, reinforce partnerships and inform policy. Within the £1.1m overall budget, Engineering funding was allocated as: £22k University staff support, £44k engineering consultancy, £142k capital funding for support and demonstration equipment purchases. The remainder of the budget was used for Food Industry support and Council costs.

SUSTAIN Lincolnshire would assist a minimum of 11 SMEs to improve resource efficiency measures and create 18 new collaborations with the University. This would be achieved through:

- 5 demonstration/knowledge sharing events
- SME clustering organisation
- developing 9 research proposals with SMEs
- assisting 3 businesses with applying for R&D grants/KTPs[4]
- 6 academic projects with SME businesses
- 6 businesses make use of Sustain equipment

1.2 Roles of stakeholders

Table 1 summarises the key stakeholders involved in the projects. Larger industrial companies, located in the County, were engaged to provide keynote speeches on energy efficiency

initiatives. An advertising company would be engaged to promote the activities and help develop the rather basic Council website pages dedicated to the project.

Stakeholders	University of Lincoln	Lincolnshire County Council	Oakwell Management Services	Peterborough Environment City Trust	Lava	Various	Siemens SGT
Status	Collaborative Partner	Collaborative Partner	Consultancy	Audit company	PR	SME	Exemplar
Number of people in the organisation	1300	4000	3	10	3		2000
Number of people involved	3	2	2	2	3		2
Role	Co-ordination and expertise	Project Audit and administration	Co-ordination and expertise	Environmental Auditing	Web	Actors	Expertise
Working hours effort	900	500	1000	500	100		
WP **Engage with SMR**	√√	√	√		√	√	
SMR collaborations	√	√	√		√	√	
Audits				√		√	
Examples	√		√			√	√

Table 1 – Key Stakeholders in SUSTAIN Lincolnshire.

1.3 Project storyline - Phase 1 – Project Initiation

Clusters creation

SME clustering was defined by the industrial consultant, who assessed company activities and clustered by output. The consultant liaised with their pre-existing contacts, which could be limiting, but provided an effective way of engaging a large number of SMEs rapidly. Three clusters of homogenous technologies were formed; Plastics manufacturing, Electrical/Electronics manufacturing and General Engineering. The initial groups were developed from the rationale that common interests and activities would promote the dissemination of best practice.

Lincolnshire County Council Website

A website[5] was set up on the Council Portal to advertise activities. This was not fully considered in the initial planning and its use was not defined. A series of initiatives to use the space were considered, but it was not effectively populated until the engagement of a dedicated marketing company.

Specialist Equipment Provision

Funding was provided to purchase specialist equipment that would have been beyond the budget of individual SMEs. Equipment was loaned to SMEs for research and experimentation rather than be for every day use. The major acquisition was an Arburg All-Rounder 270S, though further equipment, included a high speed camera and flow measurement equipment. An Arburg All-Rounder 270S Injection Moulding Machine[6] had already been obtained by the County Council, but not installed. This was readily available for the Plastics cluster use and was re-located to the University of Lincoln School of Engineering (SoE), providing a central location and research support. The machine was specialist, and expected only to meet the research needs of companies who owned such equipment already, but its availability made this a worthwhile inclusion.

1.4 Project storyline - Phase2 – Project routine and consolidation

A series of presentational events, focused around individual cluster activities were held. Content included:

- an appraisal of current activities,
- an academic presentation by the SoE,
- a presentation by an Exemplar,
- a visit, tour or demonstration.

Different combinations were tried, including all clusters together, individual cluster meetings and repeat to individual clusters (same day). No real grouping was preferred and from more than 100 SMEs attracted, group sizes at any event were typically 20. This was considered acceptable, as hard pressed SMEs were only likely to attend events of direct relevance. With events held every three months, the possibility of disengagement with the project as a whole was high and it became apparent that there was a much smaller cohort of regular supporters.

Academic Presentations

University Presentations were provided to stimulate and provoke company policy and focus, with the intention of bringing efficiency and symbiosis to the fore. Presentations on Industrial Symbiosis and the Circular Economy were followed by SoE research topics in energy efficiency, including energy harvesting and laser use in manufacturing. These were bolstered by industrial deliveries on key topics such as 3-D printing.

Symbiosis Activity

A presentation on interfacing of companies in a symbiotic manner initiated an initiative to understand cluster raw materials use and waste production. A simple form was devised to capture material flows in and out of the SMEs that could be used to identify symbiotic relationships and reduce SME waste. This would form the basis of an industrial symbiosis within the Lincolnshire area. This was a key implicit aim of the project, but lack of impetus and support meant that it achieved little traction.

Exemplar Presentations

Larger enterprises are able to devote personnel to specific efficiency activities (e.g. Siemens ITM's Business Improvement Team), that would not be feasible in smaller SMEs [7]. Larger local manufacturers acted as Exemplar's, providing presentations and advice from their experiences. Exemplars were sought for each cluster and their presentations proved largely successful. Their motivation for engagement has to be more than altruistic for this aspect to be effective.

Best practice from SMEs added valuable contributions to the discussion. In particular, the use of voltage regulation mechanisms [8] was claimed by one company to have achieved an 8% saving in electrical costs and they presented on their experiences. Another described the use of accurate flow meters to measure and control waste effluent disposal, again with significant savings.

Peterborough Environment City Trust (PECT)

A specialist Exemplar was PECT [9], who are a city council (Peterborough, Cambridgeshire) initiative focused on environmental issues. Within their project portfolio is Investors in Environment (iiE), a not for profit accreditation scheme providing the business sector with advice and auditing on energy saving measures. Through this scheme, PECT were able to provide presentations on simple energy initiatives as well as carry out a series of energy auditing activities with individual SMEs.

Marketing

Use of the industrial consultant immediately provided a large potential participant base from which to engage SMEs. However greater exposure of the project beyond its participants and the development of an effective website was beyond the scope of the consultant and the SoE. The introduction of a dedicated marketing company allowed this aspect to develop more effectively whilst freeing other participants to concentrate more fully on their core responsibilities. A Facebook page (SUSTAIN Lincolnshire) and mail shots were added to the dedicated web pages.

Arburg 270S Use

Whilst initially considered somewhat specialist, the Arburg 270S spawned a series of initiatives with companies who did not have such equipment. The idea of developing products using injection-moulded components, which, if successful, could be sub-contracted to specialist fabricators, was attractive to a number of SMEs. However, traction with individual initiatives was difficult to maintain as the complex support of these activities (die manufacture, training, etc.) stretched the resource capabilities of the project.

1.5 Project storyline - Phase 3 – Project closure

As planned, funding and support was withdrawn from the project at the end of its two-year period. It had been intended that the clusters would have become self-sufficient, though there was little cohesiveness, particularly without an effective website tool and the underpinning understanding of its use. The greater aims of symbiotic interaction between companies and across clusters was largely unfulfilled and not only greater time, but greater intensity would have been required to make this a reality. However, the incomplete activities, particularly using the Arburg 270S were simply terminated. It remained with the SoE and the industrial consultant to develop methods of progressing these projects and continue to utilise the injection moulder in the spirit of which it had been provided.

No analysis of the project was carried out by the collaborators, preventing it value from being fully assessed or assessment of the value in extending it.

Key Lessons Learned

1.6 Within the Project

There were a number of lessons were learned from managing the project, in addition to the more tangible benefits achieved in the SMEs' activities.

Positive

Non-sector engagement. Non-cluster companies engaged with the University, taking advantage of the cluster support infrastructure. This included joint research with a smoke machine manufacturer, analysing a novel method of liquid atomisation. Architecture and Art students from the University were not only able to make use of the Arburg 270S, but also the advice and support of project members. A start-up company, (producing computer hardware for schools) was similarly able to take advantage of the Arburg 270S and some key specialist advice.

Oakwell Management Services involvement. Their engagement provided a significant SME cohort within the project timescale. Hard-pressed SME's value the support of university research, but are often unsure of the mechanisms to achieve this. Similarly, the SoE encourages industrial collaboration, but had no defined strategy and its small number of staff are similarly hard-pressed. Oakwell are a well-established consultancy with good contacts to local industry and their support services, enabling them to facilitate and organise the SME engagement effectively.

Arburg 270S Plastic Injection Moulding Machine. The support infrastructure provision meant that the project had been running for nine months before it was commissioned. Additionally, the complexities and cost of tooling meant that little practical output was achieved within the project timescale. As such, its inclusion could be seen as a failure. However, it acted to stimulate creative ideas from a number of SMEs, which would not have occurred without the exposure. In addition, it attracted exemplars who were able to provide advice and support non-experts who were considering injection moulding as a manufacturing solution. As a statement piece, it stimulated discussions within the clusters and inspired a number of academic manufacturing projects, both from SoE and from Art and Product Design students. Its presence also allowed practical demonstrations for the SoE's material teaching. From this perspective, the Arburg 270S was a successful addition to the overall project, being associated with most of the engineering activities and in use more often that other specialist equipment purchased by the SUSTAIN Lincolnshire project.

Peterborough Environmental City Trust. PECT provided a direct and tangible addition to the project that was of benefit to participants immediately. The auditing activities were low level,

using recognised concepts for energy saving, but they provided an impetus and a schedule for SMEs to achieve direct efficiency gains.

Lava Public Relations. Engagement of marketing provided appropriate skills for further exposure and coordination of web based activities.

Non-Optimum

Requirements Specification. A more detailed development by the collaborators would improve project flow. In particular:

'Demonstrating new technologies' – this should not have been a key aim. Trianni and Cagno[10] show that most effect is achieved by the implementation of mature technologies. The project should focus on the demonstration of proven but state of the art, technologies, not used by individual SMEs.

'Development of the green supply chain' – this is vague. If the intent was to develop savings and synergies through Industrial Symbiosis, then this should have remained the core focus of the project and would naturally satisfy 'green' concepts. Its inclusion tended to blur the focus of operation.

Opportunities of diversifying into the supply of green goods and services, as well as driving resource efficiencies throughout the supply chain will be highlighted to SMEs through all elements of the project' - added confusion and debate to the project focus.

SME Clustering - the reasoning for clustering was unclear, with 2 potential strategies with diverse aims. Clustering of similar activities was chosen, allowing the potential for communities to form and learn from each other. However, a second strategy of clustering for symbiosis would have met high-level aims more closely.

Specialist equipment purchase: The setup of the Arburg injection moulder, inevitably took time, slowing the momentum of activity.

Negative

Symbiosis didn't become relevant for SMEs despite academic delivery on the subject, using the example of Kalundborg. Engagement of companies was difficult and would need a far more structured approach to implementation, similar to the Lean Process' use of Rapid Improvement Teams [11].

Exemplar engagement - A problem, because Exemplars didn't see any initial value for themselves.

SME Engagement – Capital expenditure provided a focus for plastics cluster engagement. No further big item expenditure beyond the Arburg was identified and the other sectors failed to engage significantly with the SoE in research activity.

Clusters did not remain functional beyond the life of the project.

Cloud sharing of data was ineffective as not all members were cognisant of the process or necessarily inclined to activate the initial invitation. The data therefore became dormant to most participants.

No project closure strategy was developed. In particular, post-project analysis by the collaborators to learn the lessons of the project and disseminate to stakeholders.

1.7 Key insight for Future Projects Management

Management can be seen as the organisational actions of Planning, Provision, Direction and Control[12]. Managerial lessons learned from this project can be similarly categorised:

Planning

Prospective stakeholders can help shape the initial definition of a project. (Typified by UK defence projects [13]). Experts supported the delivery of project, but their involvement in developing the initial concepts and specification would provide ownership, clarity and understanding. Their abilities would shape the specification to provide greater focus to the aims and rationalise expectations of the outcomes. The actors' involvement at this earlier stage would provide an early impetus to the implementation.

Provision

The scope of the project meant that it was under-resourced. In particular, the development of symbiotic relationships required greater impetus than the presentations and spreadsheet assessment provided and greater timescales to successfully implement.

Direction

Failure to release high-level documents stakeholders limited the understanding and focus of the engineering activities.

Control

Project control consisted primarily of budgetary auditing of pre-defined targets. In a 2-year project, high-level understanding of progression against project aims, with active intervention, is required to keep the project at an optimum level of operation. The concepts that are developed in the operational phase should be evaluated by the collaborators to assess their value and effect on project direction.

Conclusions

Improving the energy efficiency in SMEs can play a major role for the sustainability in the industrial sector. The "Sustain Project" aimed to support Lincolnshire SME in their journey toward sustainability. A deep reflection of this project can support the design and delivery of comparable future projects.

The project had many successes, but equally some aspects that could be improved. There were significant if un-focused high-level aims, which were probably unrealistic, give the time and resources devoted to the project. Selling the concept to the SMEs was vital and should have been a significant part of the tasking, delivered as a separate, initiating phase. Symbiosis exists naturally between companies, but it synergy that provides the highest efficiency gains. Low levels of synergy can occur fortuitously, but significant gains are achieved only through planning synergistic interaction. Providing simply achieved gains that were measurable provided achievement, impetus and marketing value to project. Use of the management consultant significantly reduced timescales of the start-up. Their value has to be contextualised in the capabilities and contacts of the collaborators, but in this project facilitated and stimulated the majority of activity.

No prior research provided guidance on the operation of this project. Although competent individual bought a wealth of experience to bear, lessons from similar projects were not discussed. The clustering was not effective as similar companies were already links and potential conflicts of interest in sharing best practice were likely. Co-ordinating such a wide-ranging project, with a large number of participants was under resourced for effective execution. No attempt was made to understand the lessons learned from the project (stimulating the production of this paper).

The inclusion of circular economy and green supply chain concepts was undeveloped. Concepts such as criticality of resource were not addressed and were complex for this level of project [14] A more protracted requirements development could have provided sharper focus to the project. The use of concepts, if not the formal tools suggested by Kaindl et al. would be beneficial. [15] Phase 3 should take advantage of lessons learned from Phases 1 and 2 and focus on tightly defined aims of symbiotic clustering. This should include a prior study to identify Lincolnshire's industrial assets and the scope for symbiosis. Without this further extension, the value of the activities already undertaken will not be maximised. The development and use of an interactive tool to provide effective interfacing of companies in a symbiotic manner should be a pre-requisite of any further development that focuses on symbiotic development. The failure to develop an integrated website suite was a significant failing of the project. Such a website could have provided space for publicity and marketing, but participant data and support tools. The failure of the cloud storage to act as an effective communication medium and provide group cohesion was predictable, given its limited abilities and passive nature. It was, however, surprising to note that cloud storage concepts were not always embraced within SME's, or other actors in the project.

Bibliography

[1] M. Quayle, "A study of supply chain management practice in UK industrial SMEs," Supply Chain Manag. An Int. J., vol. 8, no. 1, pp. 79–86, 2003.

[2] "SUSTAIN Lincolnshire Flyer March 2010," 2010.

[3] E. Macarthur, "Towards the Circular Economy: Opportunities for the consumer goods sector," Ellen MacArthur Foundation, 2013.

[4] a business of A. T. Momenta, "Knowledge Transfer Partnerships Online Website."

[5] Lincolnshire County Council, "Sustain Lincolnshire." [Online]. Available: http://www.epic-lincolnshire.org/sustain/. [Accessed: 16-Sep-2015].

[6] "Hydraulic ALLROUNDERs." [Online]. Available: http://www.arburg.com/fileadmin/redaktion/mediathek/prospekte/ARBURG_hydraulic_ALLROUNDERs_680472_en_GB.pdf.

[7] K. C. Desouza and Y. Awazu, "Knowledge management at SMEs: five peculiarities," J. Knowl. Manag., vol. 10, no. 1, pp. 32–43, 2006.

[8] C. Trust, "Voltage Managament," 2011.

[9] "PECT investor in environment." [Online]. Available: http://www.pect.org.uk/working-with-us/business.

[10] a. Trianni and E. Cagno, "Dealing with barriers to energy efficiency and SMEs: Some empirical evidences," Energy, vol. 37, no. 1, pp. 494–504, 2012.

[11] Manos A, "Lean assessment.pdf," Qual. Prog., no. February, pp. 47–50, 2007.

[12] “General and Industrial Management: Henri Fayol, Irwin Gray: 9780879421786: Amazon.com: Books.” [Online]. Available: http://www.amazon.com/General-Industrial-Management-Henri-Fayol/dp/0879421789. [Accessed: 17-Sep-2015].

[13] MoD, “Ministry of Defence Defence Standard 00-56 Safety Management Requirements for Defence Systems Part 1 Requirements,” no. 4. 2007.

[14] T. E. Graedel and B. K. Reck, “Six Years of Criticality Assessments: What Have We Learned So Far?,” J. Ind. Ecol., p. n/a–n/a, Jun. 2015.

[15] H. Kaindl, S. Brinkkemper, J. A. Bubenko Jr, B. Farbey, S. J. Greenspan, C. L. Heitmeyer*, J. C. S. do P. Leite†, N. R. Mead, J. Mylopoulos, and J. Siddiqi, “Requirements Engineering and Technology Transfer: Obstacles, Incentives and Improvement Agenda,” Requir. Eng., vol. 7, no. 3, pp. 113–123, Sep. 2002.

Keywords: Industrial Symbiosis, Energy Efficiency, SMEs, Regional Government