BUSINESS CASE: SUSTAINABLE ENERGY FOR DE-MINING OPERATIONS

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ABSTRACT

It is very difficult for companies in the industrialised West to establish business in developing countries, both because of lack of knowledge of local conditions and procedures, and because there is less infrastructure to rely on. This paper describes a case of an innovation project in which four small, Danish companies work with an NGO and two university partners to develop a sustainable energy solution for humanitarian landmine removal in Angola as an alternative to the presently used diesel generators. I will discuss the challenges that face the companies, if they are to bring the project through to establishing successful business. The challenges include defining what the value proposition actually is, picking customer segments, building customer relations, and finding ways of financing and organising a joint venture.

INTRODUCTION

In the business case discussed in this paper, four Danish manufacturers of alternative energy systems, such as solar panels and fuel cells, collaborated with DanChurchAid, a non-governmental organisation (NGO) that provides aid to developing countries. The goal is to develop an environmentally sustainable energy generator that can replace noisy and fault-prone diesel units in camps in development countries. The concrete example are camps for that house landmine removal teams in Angola in what the NGO would term 'demining operations'. A main challenge for this effort to succeed is that the distance between de-miners ('users') in Angola and development engineers in Denmark is huge, in kilometres as in perspective. The project 'Sustainable Energy for De-Mining Operations' runs over a period of 1.5 years, in part with public funding. It was originally proposed by Access2Innovation, an innovation initiative located at Aalborg University with a particular focus on solutions that target specific, urgent demands in developing countries.

The project is organised as a participatory innovation effort in the sense that care is given to involving the voices of potential users and other people with a stake in the new product, and there is a focus on the building of new business relationships between partners.

SMALL-SIZE INDUSTRY PARTNERS

The four industry partners are all small enterprises with between 6 and 30 employees. They are located in the region of Southern Denmark:

IRD Fuel Cells is a producer of small fuel cells for private households. It is a research-based enterprise with strong focus on development of this new technology. The company has a limited production in house for test systems and pilot plants. The expectation is that the company will be sold, once the technology is sufficiently mature for running production.

SunSil develops high efficient solar cells. Like IRD, it is a research enterprise with leading-edge innovation of the electronic circuitry that processes the solar cell outputs. To sell pattents is part of the business model. A manufacturing plant is planned for the production of integrated solar cells. One would characterize both theses companies as high-tech development startups, still investingheavily in development with a view to creating a profitable business in the future.

Sol-Energi Kobbervarefabrikken manufactures solar heating systems for domestic use in Denmark and some European countries. In contrast to the first two, this company has a base in skilled competence, rather than high-tech, and it has a running production of solar heating systems. The systems are tailored to the needs of each cus-

Figure 1. The combo concept. All components of the sustainable energy generator packed in one box to be transported by truck. Sketches and models are based on viewing video footage.

tomer and installed on-site.

Hannemann Engineering, is a developer of automatic manufacturing equipment for larger production plants. The company typically is invited to give bids on special equipment, and it has a number of solid customers in the local region. Hannemann participates in the project with the responsibility to design enclosures and support structures.

Of the four companies, Sol-Energi and Hannemann have started building export relations to South Africa and Tanzania (pilot plants), but other than that, none of the commercial partners have any experience with developing countries. Besides the companies and the NGO the team includes three other partners:

Aalborg University brings expertise in power grid management and is expected to develop the technology required to transform sustainable energy inputs to electricity mains.

SPIRE with its competence in participatory innovation is responsible for the study and involvement of users throughout the innovation process and for the design of the user interface of the generator.

South Denmark European Office, a lobby unit financed by the local region to support companies in ensuring EU funding, acts as project manager.

The project team thus brings together a significant variety in development practices from concrete customer adaptation via high-tech development to university research.

FIELD VISITS AND WORKSHOPS

Already rior to the planned field visit in Angola, SPIRE organised a first design workshop using video to represent user perspectives from demining camps. The goal of the workshop was to start the search for solutions with focus on critical issues such as user operation, maintenance, transport, instructions etc. The video footage was borrowed from a TV photographer, who had visited demining operations in Congo two years previously, and it was employed to ensure that initial ideas would not be grounded solely in Western preconceptions of life in the developing world. The team produced two possible design directions: An integrated unit in the form of a box, from which solar panels would unfold, or a set of smaller, portable units to be connected on-site, Figure 1 and 2. The team also made the decision to prepare a simple mock-up in time for the Angola fieldtrip.

The fieldtrip was organised by the NGO partner 4 months later. Five team members joined the 10-day travel that included observations in demining camps, interviews with deminers and managers, studies of local generators

Figure 2. The module concept. Each part of the generator are transported piece by piece and then assembled by technicians in the camp.

Figure 3. Deminers and NGO managers map out electricity supply options in Angola.

and local consumption patterns etc. During several workshops following the Angola fieldtrip the team came up with the a plug-and-play power converter module that can take the energy from any alternative source (sun, wind, water turbine, fuel cell) and turn it into a reliable power supply for camp operations. Over the course of 6 months the partners developed a prototype generator for test in Denmark and later in a de-mining camp in a developing country.

The fieldtrip and subsequent negotiations with the NGO has however made clear that there are many obstacles to making this innovation become a success beyond the design of the generator: There is the attitude towards relief aid in the local government, the non-existing 'energy savings culture', procedures in NGO camp management, procurement practice when setting up a new demining operation etc.

At two later workshops the team discussed potential business models. The main business challenge at present is to find a way of organising a company or company network to develop the project further. Also, to strike partnerships with NGOs seems crucial both to develop an attractive solution and to develop business. In the following I will discuss what appears to be the prevailing challenges in relation to creating a viable business model for the project.

ANGOLAN GENERATOR CULTURE

One of the observations that came out most clearly from the field studies in Angola is concerned with how locals relate to energy consumption. We came to talk about this as a 'generator culture'. In many areas in Angola people cannot rely on a city grid of electricity supply. In areas where public supply is available at all, it may be unreliable and only work for intermittent periods

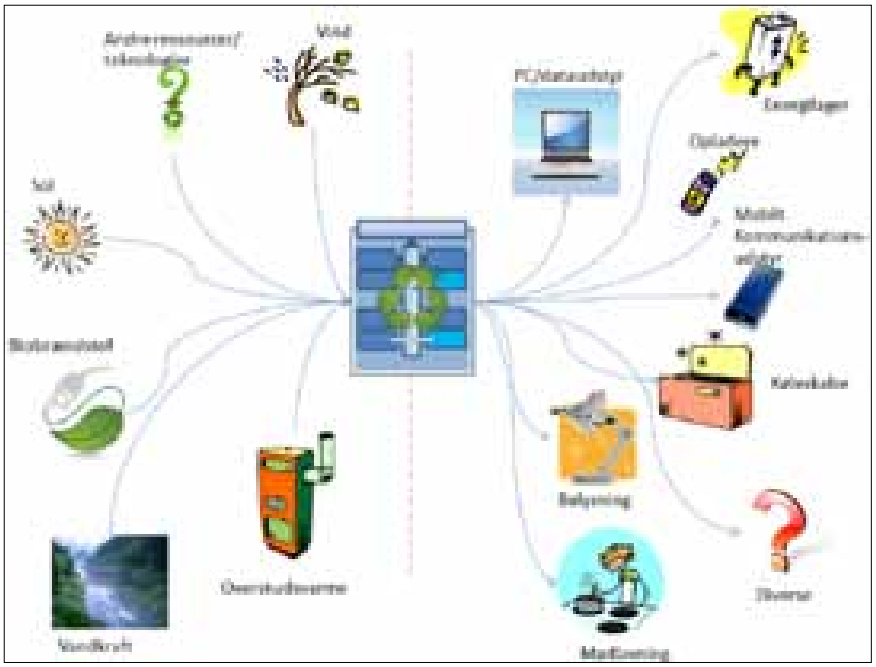

Figure 4. A schematic put forward by the electricity grid researchers. It shows the converter unit as a central element in converting electricity from energy sources to energy consumers.

of the day. Instead, many families and organisations rely on their own small gasoline fuelled electricity generator, just like the demining operations do. These generators will typically run for a couple of hours in the morning and in the evening.

This has implications for the project: On the one hand, local people do not have a concept of 'energy saving'. For instance, most lights in the camps and elsewhere do not have on-off switches, because there is no need: When the generator comes on, all the lights turn on. When it stops, all the lights go out. With an alternative energy source yielding to 1-2 kW, compared to the 6-8 kW of a regular camp generator there is a serious challenge to make the power suffice. The lower power level may be feasible, but only with a combination of technical measures (low-energy lamps, for instance) and energy savings behaviour (to even out consumption periods). A change in behaviour may be very difficult, but a way forward may be offered by the fact that demining camps are managed by strict protocols; they are run much like a military operation. So potentially energy saving measures could be spelled out in camp procedures.

On the other hand, local people in Angola do understand that there is a direct relationship between electricity consumption (lights, TV etc.) and electricity production (their generator), a relationship, which has long been lost in Western societies. To us Westerners, electricity seems available from wall sockets in constant and limitless supply. Even large economic incentives in the form of low-tariff periods persuade few Western householders to schedule their use of washing machines to night time, off peak production periods. In Angola, there might be an opportunity to utilize this production-consumption understanding in the design of a new system, rather than produce a design that mirrors the detached system of the West.

THE UNIT WITHOUT A NAME

What is the value proposition actually? From the outset, the energy grid researchers suggested that the core challenge of this project is to develop a grid unit that converts the DC current from the various alternative energy

Figure 5. Angolan deminers test the handling of a mock-up of the converter unit, at a time when measurements were yet unknown. The mock-up was simply an empty plywood box 100 x 100 x 50 cm containing batteries for weight. Based on this experience, all agreed that this size was far too big for easy handling.

Figure 6. A scale-model of the converter unit design, now with wheels for easier transport. Both size and weight actually turned out larger than those of the mock-up.

sources into AC current for the camp consumers. The visualisation in Figure 4 has been so powerful in steering the project that most attention from the project partners has been focussed on developing this unit. Paradoxically the 'unit' through the entire process hasn't found an appropriate name. This indicates that it might be difficult to verbalize precisely what the value proposition actually is. Technically, it can be explained that an energy conversion needs to take place, but as this unit (in the prototype version, Figure 6) is several times as heavy and many times as expensive as a conventional diesel generator, and as it is actually *not* a generator in itself, it is a challenge to think of *unique selling points*. Add to this the challenge that a move to alternative energy sources necessitate a shift to low-energy devices and an energy conscious behaviour of the operating staff, this project has serious obstacles to overcome. The total offer may thus be a combination of:

- Alternative energy sources (solar panels, wind turbine, fuel cell etc.),
- The grid converter unit,
- A plan for optimizing energy consumption in the camp, and
- A concept for changing consumption behaviour among camp staff.

CUSTOMERS & SALES CHANNELS

There are different target customers:
Non-Governmental Organisations is most obvious, given the project premise of supplying a system to camps in off-grid areas in developing countries. For NGOs to purchase a sustainable energy generator would require them to include an offer in their bids for contracts. This has the advantage that investment and running cost are calculated together, the generator is an expensive investment, but cheap in operation. A green image could count as unique selling point, although not as a decisive one. Generators would likely need to be tailored to each location.
Emergency relief camps are another potential market. These camps, also run by NGOs, are established practically over night, when disaster strikes. But the requirements are different. To supply this need would require standard, container packed generators available in stock for air transport within days.
Commercial enterprises (e.g. building contractors of new supermarkets) in developing countries could be a third customer segment. This would, however, require very strong arguments on the investment/ running cost balance, as these budgets are often kept separate in the construction industry.
An important insight gained in the business modelling workshops was that a sales effort would require assisting customers (NGOs) in planning the right combination of alternative energy sources, depending on the availability of sun, wind, water streams and the character of the electricity consumption of the operation in the particular region of the world. This becomes much more complicated than today's simple estimate of a maximum kW figure.

WHO CONTRIBUTES RESSOURCES?

The challenge of developing, manufacturing and marketing the sustainable generator can not be tackled by any of the four commercial partners acting alone. For this, the investment required is too large and the risk too big. Some form of joint venture is called for. But the question of 'who is in and who is out?' is a delicate one. The company *Sol-Energi,* for instance, joined the project on the premise that demining camps would have a need for hot water supply besides electricity. This seemed not to be the case in Angola - so this partner naturally is in doubt about their continued participation. However this would be a loss to the project team because *Sol-Energi* has the most extensive experience in concrete customer negotiation and day-to-day adaptation of solutions.
To support this dialogue between the partners, SPIRE solicited graduate students to design a 'tangible business model' that would encourage the companies to explore investment options in a playful manner. The students developed a brick game in which each of four company owners contribute resources (coloured bricks) to a joint venture (tower) in Africa from their own companies (towers) in Denmark, Figure 7. The 'Joint Venture' game has three phases: In the first, the players take turns adding bricks to the shared construct, as an up-front investment. In phase two, they need to grow the shared tower organically by reorganizing bricks, but not adding any more resources from home. In phase three, the players shall attempt to withdraw revenue from the joint venture (the shared tower), without de-stabilising it!
The game did manage to support a constructive discussion. For instance did the colour of the bricks make the origin of the ressources recognizable throughout the process, which triggered the discussion of who-owns-what? And can companies pull out 'their own' ressources (e.g. machinery specific to one partner) again, once they have invested in the joint venture? At the time of writing the future of the project is still open.

Figure 7. Managers of small, Danish companies play the Joint Venture *game. A 'tangible business model' that encourages participants to discuss how several companies may pool resources and create revenue in a joint development country venue.*

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