Entrepreneurs, Technology & Sustainability

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Cover image: *Gloriosa superba*, photo taken by Louise van Mourik.

Entrepreneurs, Technology & Sustainability

designing and funding technologically driven sustainable start-ups

an introduction

Pieter van Mourik & Hans Bonnet

Delft Academic Press

Preface

Human beings seem naturally entrepreneurial. The human conquest of the world in a rather short period of time (remember that the human race enters rather late in the global history) would not have been possible without the exploring and exploiting attitudes of human beings. For exploration and exploitation human beings have to use all their facilities as the human race is rather a misfit in his surrounding biotic and a-biotic environment. The Bible book of Genesis is symbolic about the first period of history: the Earth is empty and full of wasteland and humans were exposed to all forces of Nature. For a citizen of a European country, that period seems irrelevant. Nevertheless, forces of nature can still intrude daily life, even in developed countries. Think of hurricanes and tsunamis, but also of *incurable* diseases.

How can humans react on such challenges? By entrepreneurship that enhances survival possibilities. Until the publication of the Report of The Club of Rome in 1972, *The Limits to Growth*, the prevailing idea was that the Earth offered to mankind unlimited possibilities for the fulfilment of human needs. Since then the insight arose that present generations bear responsibility for the fulfilment of needs of future generations (Brundtland, 1987). For this textbook, the Brundtland description of sustainability is taken as: *the fulfilment of needs of the present generations should not affect that of the future generations*.

Humans are entrepreneurial, but not all humans are entrepreneurially equal. Some people are more entrepreneurial than others. In all day life some people see more opportunities than others. An initiating entrepreneur sees opportunities for new economic functions creating new values. Human societies are gradually more and more based on science and technology. The explosion of the information technology at the start of the 21st century is a striking example. Hence, engineers and scientists often witness new developments and new entrepreneurial *opportunities*. To acknowledge such opportunities entrepreneurship is a *condicio sine qua non*. Therefore, already in the 1990's it was decided that students of Delft University of Technology should be acquainted to entrepreneurship in an educational surrounding of studying by doing. In view of the Brundtland report, this entrepreneurship should be based on sustainability. Students are challenged to design a start-up based on a technological innovation that contributes to a sustainable development. The result of this design process is a written business plan to be presented to *colleagues* and *potential investors*. To facilitate the student's efforts, background information was made available. This background information appeared to raise interests in and outside the university. Hence it was decided to write this textbook, an initiative taken by the second author. This is the first English-language edition of this textbook, originally only available in Dutch. To that original edition, important contributions were made by dr. J.N. Quist (Faculty of Technology, Policy and Management of Delft University of Technology). To the present English-language edition contributions were made by dr. R. Pierce (Faculty of Applied Sciences of Delft University of Technology) and by dr. S. Lemkowitz (Faculty of Applies Sciences of Delft University of Technology). We thank the publisher for his efforts.

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1 Enterprise, Technology and Sustainability

1.1 Introduction

To start a business is to undertake a venture and to make ultimately a profit, thereby hopefully improving existing products or services. This is a simple concept that everybody understands. Virtually everyone sometimes thought: that's a good idea…. that's the product I'm going to produce and to sell to make huge profits! The essential point here is to acknowledge needs and to see the possibilities to fulfil those needs. The first question that often arises is who will benefit from those profits originating from those sales? The obvious answer is, of course, the initiator of that wonderful product: the entrepreneur. This answer assumes that the entrepreneur is the person that came up with that wonderful idea. If the idea originates elsewhere, the answer already becomes more complicated. The entrepreneur may also start from an invention or maybe he/she is an inventor him/herself, e.g. during studies he/she encountered an invention or did it. Then the idea arose to use this invention to fund at start-up, a firm of and on its own. Funding such a firm involves many people around the newly born entrepreneur. In real life others take an active role, for example, his or her future customers, but also local, regional, national and international governments and regulation agencies. So, embarking on an enterprise by an entrepreneur may seem an individual action on an individual basis, but is in reality an activity filled with multiple human relations. Sharing profits is, therefore, inevitable for each entrepreneur. For example, loan interests and taxes must be paid in time.

The second question to arise is much more important, especially for this textbook: under which circumstances a new enterprise can originate, or in other words: *how can you start a new business?* If continuity of human activities corresponds to available resources, these activities can be characterized as sustainable. Starting a new sustainable enterprise can be conceived as a design problem with the following boundary condition: the new enterprise is economically viable and sustainable. Here lies the difference with ordinary new enterprises, which only need to be economically viable. The focus of this textbook is new enterprises that originate their sustainability from their technological roots. In this conceptual framework, technology is described as the means by which human beings make use of their resources. Sustainable technological enterprises are based on technology and contribute to a sustainable social development. The design of a new enterprise is a plan, commonly known as a business plan. In the foregoing phrases, three key elements are present: enterprise, technology and sustainability. These elements are mutually related. The connections form a triangle (see Figure 1.1). In the further course of this introductory chapter, the key elements will be described in two ways. First, we will describe two cases assembling these three elements. Then, in the appropriate Sections of this chapter, we will give some explanatory descriptions of the key elements concerned.

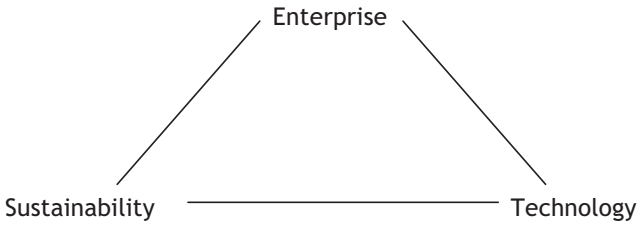

Figure 1.1 Triangle of Enterprise, Sustainability and Technology

1.2 Turning Technology into Business: Two Cases

1.2.1. Biological UV Filter

In two studies [Jacobs et al, 2007, and Cassani, 2009] it was shown that the wax layer on the needles of the dwarf mountain pine (*Pinus mugo* subsp. *mugo*) provided protection against harmful UV radiation. It also appeared that this tree had found a way of coping with the UV-light, by converting part of the harmful radiation into useful light, keeping the plant safe from cell-deformation. It appeared that the UV protection of *Pinus mugo* subsp. *mugo* is quite effective. As ageing of many traditional UV protection layers decreases their ultimate protection, it seems obvious to apply the mechanism of the UV protection of *Pinus mugo* subsp. *mugo*. Therefore, the latter UV protective wax layer could be mimicked to create UV protective layers with a wide range of human applications ranging from cosmetics to aircraft paintings.

There might be several ways to transform the biological mechanism into human applications. One approach would be to separate the wax layers from the needles of the dwarf mountain pine and to incorporate these substances into human products like cosmetics or paintings. A second approach would be to identify the substances of the wax layers responsible for the UV conversion. Both approaches are in essence technological, but the resulting processes should also meet criteria of efficiency and effectiveness. An important technological question is, of course, how the separated wax or the isolated UV protecting substances can be assembled into the protective agents for a specific human application. Obviously, the way a sun protecting gel is applied on the human skin differs considerably from an aircraft painting. Another important question is the durability of these UV protecting substances; are they really immune to UV radiation?

The range of human applications of such a sophisticated UV protection is indeed large. However, the truth of this statement says nothing about the economic viability of the above indicated technological processes. Whether or not UV protection based on the biological conversion will ultimately prove to be sustainable, will depend largely on the outcome of the comparison with existing, “traditional” or common UV protective products. Potentially, the biological UV protection has the great advantage of its proven effectiveness. Under which circumstances this may lead to an enormous increase in the lifetime of painted constructions like aircraft, remains to be studied, just as the overall contribution to sustainable development of biological UV protection remains open.

1.3 Designing a Business Idea

Each enterprise starts in a virtual reality. The idea for a new enterprise is called a business idea. The originality of a business idea often sticks in questioning routine practices, either in daily personal life or in daily commercial or industrial experiences. Querying remains a very important source of innovations as it yields acknowledging shortcomings and/or incomplete functioning and satisfaction of needs and demands. Here lies the seed of new ideas for new enterprises. An example may be helpful.

General medical clinics can have long waiting times due to the inevitably mix of medical and social problems they have to deal with. Professional sports nowadays represent huge social and financial interests. Think of football, skating, tennis, golf and cycling. The medical specialists involved play their roles in view of financially boosted demands on quick and easy treatments of injuries. In view of this, experienced orthopaedic specialists may decide to fund their own commercial specialized clinics devoted to professional sportsmen or sportswomen who can then be treated without any waiting times or waiting lists, e.g. *Curing on Demand Ltd*. Of course, such clinics should meet legally established requirements in addition to the requirements set by the relevant sport.

In general, ideas for a start-up are rather vague and implicit and should become more explicit and related to social problems. In this phase two difficulties have to be overcome: the ideas themselves and the relation with these problems have to be articulated as sharply and concisely as possible. Which problem does the idea address? The basic approach sketched in the foregoing phrases is that of an industrial design, where a List of Requirements (=LoR) is often guiding the whole design process. Indeed, starting a new business can be conceived as a design and its realization.

The first contact of a business idea with daily economic reality is the viewpoint of a potential investor. Engineers as initiators generally find it very difficult to look upon their ideas from an investor's viewpoint. However, in each stage of the design of a new enterprise the investor's viewpoint is essential as it reflects the role of capital in starting a new business. The business idea, the investor and the initiator of the business idea schematically form the corners of a triangle showing the intimate strong interactions between these corners (see Figure 1.2).

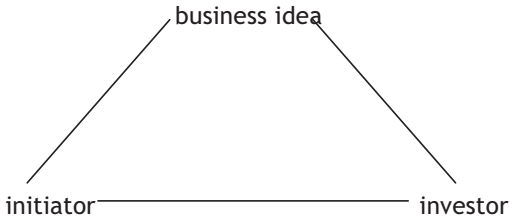

Figure 1.2 Triangle of initiator, business idea and investor