A Technology Management Model for Entrepreneurial Business Ventures

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Abstract--**Managing Technology effectively and competitively in a fast-moving globalised world has become an increasingly challenging endeavour. Design, Information and Action (DIA) as defined by the authors have been found to be key aspects which significantly influence the degree of innovation, competitiveness and business leadership achievable.**

A technology management model was developed on the basis of these three key aspects which are further cascaded in five levels of business-space derived-dimensions in a systems hierarchy to enable non-traditional managers (Entrepreneurs) to run their organisations. The understanding and judicious application of inter-relationships of these dimensions have been found to be critical to improved effectiveness in technology leadership and competitiveness.

The paper elucidates the details of the management model and describes the initial research conducted especially on the DIA entrepreneurial space as well as on the applicability of the model in a global scenario indicating possible mapping dimensions to selected companies in diverse technologies in three countries. The integrated outcome of the study is a management model that consists of critical management literacies which are essential for every Entrepreneurial Business Venture.

The importance of the unique combination of the factors Design, Information and Action with regard to Entrepreneurship and the cascaded dimensions is shown in preliminary bibliometric data or literature searches that may eventually be useful in representative case studies which make use of the nine critical management literacies.

I. INTRODUCTION AND RESEARCH APPROACH

Entrepreneurship has reached a new stage of intensity, diversity and even meaning in recent times, especially over the past 10 years, due to the scope of possibilities presented by the ubiquitous internet and related digital technology. Entrepreneurship, start-ups and the lure of instant business success based on a concept or an innovative idea has mushroomed as is evidenced by the number of courses, books, university programs and new type of Start-up schools and institutions that cater for this apparent need [1 - 4] [37 - 39].

The majority of younger people, mainly the so-called Millennium Generation born during the 80's and 90's, has no desire to follow a traditional career and is looking in ever greater numbers – some sources claim over 65% in Western countries - to start their working life with their own start-up business [11]. This is then attempted with many ideas, courage, but typically little business background. The internet combined with the easy-to-use high technology possibilities available today have created a completely new playing field which makes this possible, but with its own risk and uncertainty of outcome. The internet of ten years ago is also very different to the internet of today; it is more developed in infrastructure, much greater in scope and opportunities, mature in terms of low cost communication, sharing, exploring, collaboration etc. and incomparable to the internet whose bubble burst spectacularly during the 1990's [2] [4] [11].

This almost Cambrian creative explosion-like development over the past 5 years will create new possibilities and new challenges for the individual but also for all size companies and businesses be they in banking, health, manufacturing, book publishing, chemical and biological research, creative arts, film making or teaching at Universities. It will – and already does – influence the interaction style, the collaboration models and the way this seemingly multi-nodal exponential growth will have to be managed. It looks messy from the outside and any exponential growth of this development can only be handled within a system thinking approach, a more than usual awareness of the business space and with due regard to a limited number of fundamental guidelines rather than fixed laws or rules. Many variables, all changing at high speed, moving in various directions simultaneously and possibly across international borders require a different paradigm in managing entrepreneurial business ventures [3] [4] [6] [11].

The trends are not too difficult to discern but more emphasis must be on how it will influence the handling of relevant information, innovation, design processes, productivity, effectiveness and efficiency, ethics, sustainability, communication and global competitiveness. How well will we be able to manage this potpourri of possibilities and challenges? How can we get structure and discipline into this kind of rather fluid scenario?

The authors of this preliminary research paper have had considerable exposure in the up-slope part of this exponential curve both in an academic post-graduate teaching sense but also with over two decades practical experience in the high-tech industrial environment. The actual start-up is not what we are so much interested in, but rather how the process will be managed after the business is well established. We are not primarily interested in how a great idea and a quickly established website or blog can initiate a money making business, but rather how such a fast growing, organic entity can still be managed successfully with limited or no traditional management skills [24 – 27] [34].

Fact is that many of those millennial youngsters start businesses without the background that is traditionally seen as necessary, even if not sufficient, such as proper (academic)

training, knowhow and experience to run a multi-national large business with internet roots [3] [37 – 39].

Examples come to mind, such as Facebook, Google and GoToWebinar all started by entrepreneurs with a good idea and probably little relevant experience. But it is equally challenging for hard-product companies such as Apple[1], Dell[2], Weber Medical Instruments[3], BEMER Vascular Therapy[4] who in their own peculiar manner were entrepreneurial business ventures in the high technology arena.

The latter are organisations that have been around for a relatively long time (at least 15 years), they are currently very successful and they were started by entrepreneurs of different backgrounds, ages and approaches to Design, Information and Action.

The research question arose many times in discussions with high tech industry leaders and post-graduate students with practical work experience [36], if such a development must be / can be traditionally managed or should rather be led and guided by means of adherence to a limited number of fundamental qualities which can assure a coherent, flowing, high quality desired outcome? This led the authors to apply an exploratory research method in this albeit a preliminary research investigation leading to the development and focusing on the merit of a new management model for high technology entrepreneurial business ventures in a highly competitive international environment.

For the purposes of this paper the focus is only on the conceptual model development that is in some sense grounded in literature but more importantly in practice. The empirical testing of the model will not form part of this paper but will be included in possible future research. The inherent usefulness of the conceptual model may however at this stage of the research be deduced from the literature scope addressed as well as the action research and experience base of the authors.

II. THE PERCEIVED PROBLEM

Management is traditionally defined as Planning, Leading, Organising and Control and getting work done through people. Management attempts to achieve goals and achieving the needs of the requirements in industry within financial and milestone constraints. This model is of very limited use in this new entrepreneurial era and this is the focus of this paper. It is recognised that there will still be large and small businesses which employ traditional management approaches especially in manufacturing, logistics, banking etc. But even that is changing in part due to the super-fast digital internet technology, but more so due to the social interaction of people via the internet and fast communication influencing the way in which promotion and brand building takes place.

How can entrepreneurs in this modern high tech enabling time be guided and made aware of the challenges they will face as the business grows, without traditional management experience and training? How can the complexity that has to be handled by such entrepreneurs be articulated, structured in a sensible framework and what tools of management can be developed, if any, to make this feasible over a wide scope of talents, personalities, industries, products, services, value contributions and over sometimes vast global distances? What personal and functional competencies may be required in such a scenario? Which aspects may be key to a successful, sustainable entrepreneurial business venture? Can such a model be developed in a practical application sense and also make a contribution to the field of technology management?

It is in the light of those questions, which will not all be addressed in detail in this paper and which have no straight-forward answer for Entrepreneurial Business Ventures in the High Tech area, where a non-conventional approach was chosen. This approach is certainly a systems approach, multi-dimensional and rooted in fundamentals rather than specific techniques to accommodate the fast-moving, vacillating, risk-prone, entrepreneurial space in which the business venture must develop and mature.

III. RESEARCH AND SYNTHESIS

A. Brief literature survey

The authors have relevant academic and real-life experience with respect to high-tech entrepreneurial business ventures in an international context and have been investigating this topic for a number of years. With the considerations elucidated in the introduction above, a literature survey was undertaken, based in part on pre-selected authors, key-words in Google Scholar and personal action research experience [36].

It is clear that with the engineering background of the authors, technology here implicates the larger picture of engineering-specific technology and the entrepreneurial business venture refers to the application of the management of such technology. Yet the conceptual approach and the management presented here may even be of value in other business environments but has still to be assessed as such in future research.

The literature available is extensive and for the scope of this paper a couple of representative references have been selected as they best represent the point the authors wish to make. In a manner of speaking we are drowning in a sea of information, but in this paper we attempt to filter out the relevant knowledge in a systems context and get to see the impact-making bigger picture for a management model that would be sustainable and would "work".

The authors used as a starting point three key-aspects important for Entrepreneurial ventures: Design, Information and Action.

[1] www.apple.com
[2] www.dell.com
[3] www.weber-instrumente.com
[4] www.bemer.co.za

Whilst many key-words could be chosen, the choices fell on Design, Information and Action as the literature of the past 10 years had a reasonable consensus that these three are included in almost every discussion of entrepreneurship in a technology environment.

Steyn [23] emphasised that design is a complicated, hierarchical and diffuse process of negotiated mutual accommodations and that design has a wider scope than simply understanding, natural flair to create and scientific knowledge. Steyn emphasised that the complexity in system design which almost always requires choices consists of many simple conceptual ideas which represent complex reality. In fact, Steyn considers entrepreneurial business venture design to be a mapping of system engineering design but with arguably even more uncertainty in the business model than with engineering models. Senge [21] and Vester [22] are similarly focused on the system thinking approach and their application to entrepreneurial business ventures is a direct one.

Others consider sustainable entrepreneurship to be a direct outflow of good design and relevant information, [15] [18]; some build elaborate models for prediction [30] while yet others require a successful entrepreneurial business venture to be driven by pragmatic adequacy [17] and the theory of effectuation [33] both of which imply action driven objectives.

Sustainability has its own subcategories but always implies good design and the correct, relevant and timeous information for making choices and decisions. De Geus [32] looked in some detail at the parameters that matter for business ventures of many types, including entrepreneurial high tech companies looking at long-term sustainability as well as longevity. Excellent design and relevant information are always at the forefront for the start up, the growth and sustainability of the venture.

Product design in terms of many facets artistic, scientific, utility, economics, life-cycle costs, sustainability etc has been well explored – for example [8] - but one of the most pertinent aspects in entrepreneurial business ventures in today's digital age is creativity and innovation. When does creativity change to useful and sustainable innovation is a pertinent question for a complex entrepreneurial business venture. Grulke [10] von Stamm [13] and Tidd & Bessant [14] provide a comprehensive framework. Again the design approach together with the innovation applied and the relevant access to information strategic and operational will impact the success and sustainability entrepreneurial business venture.

Success and failures of entrepreneurial business ventures were also considered, for example Yap [19], that focus on small entrepreneurial high tech firms whilst the initial drive is of course to create entrepreneurial wealth in high-technology start-ups [16].

Neck [31] and contemporary albeit non-academic literature such as for example Wired Magazine [37] [38] push the frontiers of entrepreneurial education and are also very relevant in this context.

The important role of tacit and explicit knowledge management [20], R&D as a separate, distinct category [16] and of course overall strategies in terms of funding, product development, marketing and distribution [19] have a high relevance in this overview. Porter's seminal work [28] of the Diamond model of the Determinants of National Advantage alludes strongly to the information and action key-dimension and is as relevant today as when it was published in the 1990's.

Excellent research was conducted by Platzek [12] who shed considerable light on this initial analysis of entrepreneurship albeit with application to company-internal entrepreneurship, i.e. intrapreneurship. His models were refined in particular applications in [24 – 27] where [24] and [25] is of particular interest for the background of this paper.

B. The Entrepreneurial Space

As we are mainly concerned with technology driven entrepreneurial businesses we define technology to encompass a wide range of issues, disciplines and utility. It ranges over a wide spectrum, from engineering and life sciences to web-based enterprises and can imply products, processes and systems.

Entrepreneurial business ventures in the technology area are highly dependent on,

a. Innovative ideas leading to smart DESIGN
b. Relevant INFORMATION leading to awareness, knowledge and application
c. Correct application of ACTION which must leading to sustainable brand building

These three key aspects constitute a simple definition of the Entrepreneurial Space within which in a qualitative sense all decisions with regard to the business venture will be made. These three key words were chosen on a qualitative basis as a result of the literature survey and even if somewhat arbitrary, they encompass the Entrepreneurial Space. According to our model all the essential elements of Entrepreneurship are assumed included in this space.

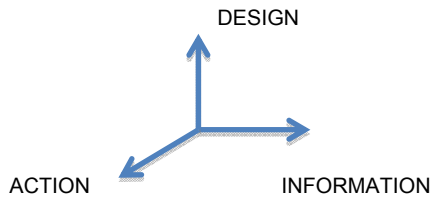

Figure 1: Entrepreneurial Space

The planes
Design – Information (DI),
Design – Action (DA)
Action - Information (AI)

provide the three areas where specific *dimensions of interaction*will be demonstrated further enhancing the model.

Entrepreneurship goes hand in hand with design and relevant and timeous information which must result in appropriate activities. Entrepreneurship also requires very specific personal attributes: a propensity to accept calculated risk, drive, courage and able to make correct choices amongst a number of options. These will be covered in the Action dimension of the space.

What we understand by Design, Information and Action from the literature review integrated with experience of the authors in an action research setting, in the context of entrepreneurship is briefly elucidated in the following subsections:

C. Design

Good design, or what Peters [6] and Steyn [23] called smart design, depends on a number of soft attributes which make the differences between great acceptance in the market place and a non-impact product or service,

- The degree of Innovation,
- Satisfying a Need,
- Creating or playing to Wants,
- Giving rise to Emotions such as Desire and possibly emotion for the Brand,
- In other words an Identification of the customer with the Brand,
- Which is reinforced by Packaging & Aesthetics
- And Promotion and referral by others (Word of Mouth)
- Of course Quality, Value and Sustainability are a given in the modern world as is integrity and ethics.

The Design must simply be innovative, appealing, brilliant, effective and affordable. Add to this competitiveness and an ability of the potential customer to identify with the product in a believing-in it sense. Of course the product must also exhibit excellent utility, reliability, maintainability, quality and other functional and physical characteristics. Design thus encompasses a large number and very diverse set of factors. The System is the Solution as quoted by Gerber [1].

The design process is assumed to be understood and well known in each case and the various design methodologies and techniques as elucidated by Ulrich [8] and Steyn [23] for example, are not in the scope of this paper but are accepted as given.

Design was characterised by the following key words,

- Utility, Requirement
- Innovation & Creativity
- Need
- Want
- Perceived Value
- Quality
- Sustainability
- System Approach
- Multi-disciplinary

D. Information

Information covers many aspects of the business space and the time dimension from a current and future perspective,

- appropriate knowledge of the product or service,
- access to emerging technology and trends,
- understanding the clients,
- insight into the industry,
- information on who are the real competitors, real customers, ie real target groups
- reading the trends of the times and social attitudes,
- knowing the sensitivities of the respective potential customer groups
- access to relevant knowledge

The entrepreneur needs to possess the traditional requirements of courage, drive, belief in him/herself, be passionate and always on the look out for critical / radical information. It must be clear that not only must the information be available, sought out, acquired but must be understood in a bigger picture scenario and what potential opportunities and threats are locked up within the information. Information can also pertain to a diverse range of topics and scope in terms of the type of information and Intelligence required and considered for an entrepreneurial business venture.

Information was characterised by the following key-words,

- Technology
- Trends
- Competitors
- Client (Market)
- Industry sector
- Political
- Environmental
- Financial
- Impact of Innovation
- Systems Hierarchy

E. Action

Action covers many aspects of entrepreneurial activities such as the constant pursuit of the idea, courage, energy, persistence, consistency and sheer drive. But there are deeper implications on the action side:

- Action requires an awareness of the past, the present and the future
- Action requires judicious decision making and courage
- Action implies energy in the relentless pursuit of the innovative idea and overall strategy
- Obstacles are recognised and are handled judiciously and decisively
- Risk is minimised by the choices made

- Change if necessary is implemented and the resulting stress is managed
- IQ, EQ, competence and healthy self-confidence are visible in the actions taken
- Leadership and vision as to direction of the business venture is clearly articulated in the decisions made.

Accurate information plus a brilliant design will not automatically result in a successful entrepreneurial business venture [23]. Action may seem a trivial point to add as a separate axis to the entrepreneurial space but often enough the entrepreneur is preoccupied with the first two key aspects and leaves the decisive action to others, be it marketing, identifying the market or finding external investors or delegate important action to others who may not have the same vision as the entrepreneur.

The exposure of the authors to many different entrepreneurial business ventures in an international context have found the success to be more certain if all three key aspects are addressed simultaneously, relentlessly and passionately – with wisdom as displayed by the choices made.

Action was characterised by the following key-words,

- Drive
- Attitude
- Aptitude
- Paradigm (Mind-Set)
- Persistence
- Consistency
- Communication
- Leadership
- Seeing the bigger picture

F. Dimensions of Interactions

As indicated above, the three planes of interaction are characterised by two-dimensional interactions of the apexes Design, Information and Action as depicted in the triangular presentation of figure 2.

DA represents the direct influence between Design and Actions to be taken, DI between Design and the relevant Information and thirdly the influence that Information has on Action.

The Interaction dimension between Design and Information is mainly about *Purpose.* The Interaction dimension between Design and Action is about making *Decisions.* The Interaction dimension between Action and Information is about *Risk*

These considerations provide the backdrop as to the issues and challenges that have to be addressed in a suitable management model presented later in the paper.

Looking at these important aspects we recognise fundamental requirements: a systems thinking approach, the need for concurrency as well as marketing and promotion aspects which are not easily managed in functional departments, if at all, in an entrepreneurial environment. This is not to say of course that there are no functional departments in the business venture but to keep the entrepreneurial drive consistent and successful requires a different paradigm. Especially if the innovation represented in the design will be very disruptive to the status quo.

We now have the entrepreneurial space axes Design, Information and Action and the three Interactive dimensions DI, DA, AI designated as Purpose, Decisions and Risk.

Design + Information yielded PURPOSE in a qualitative sense; similarly
Design + Action yielded DECISIONS and
Action + Information yielded a RISK dimension.

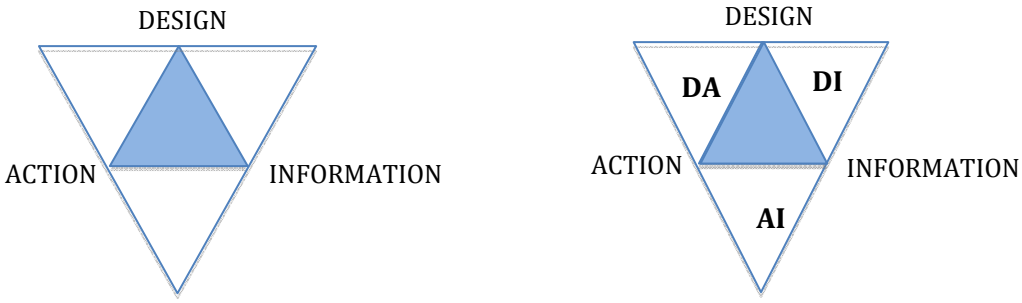

Figure 2: The interaction between key-aspects Design, Information and Action

TABLE 1: KEY WORDS OF THE ENTREPRENEURIAL SPACE AND THEIR INTERACTIVE DIMENSIONS

DESIGN	DI	INFORMATION	AI	ACTION	DA
Utility, Requirement		Technology		Drive	
Innovation & Creativity	***P***	Trends	***R***	Attitude	***D***
Appeal and aesthetics	***U***	Competitors		Aptitude	***E***
Emotions	***R***	Client (Market)	***I***	Paradigm (Mind-Set)	***C***
Need	***P***	Customer sensitivities		Energy (Persistence)	***I***
Want	***O***	Social attitudes	***S***	Consistency	***S***
Brand	***S***	Industry sector		Communication	***I***
Break-through	***E***	Political	***K***	Strategic & Operational	***O***
Perceived Value		Environmental		Ethical	***N***
Quality		Financial		Decisive	
Sustainability (ecology, financial etc)		Impact of Innovation (Incremental/revolution)		Leadership	
System Approach		Systems Hierarchy		Multi-Focus	
Multi-disciplinary		Filter and tailor information		Seeing the bigger picture	
Why?		*What?*		*How?*	

Google Scholar was now used mainly as a qualitative tool to find Papers published since 1990 which connected Design – Information as well as Design - Action as well as Action – Information in any form and in any entrepreneurial business venture context.

Individual papers were scrutinised in their abstracts for the listed key-words of section 3.3 Design, 3.4 Information and 3.5 Action. It was found that with over 110 Papers scrutinised that virtually all the key-words were found as well as many of the intermediate implication of Purpose, Risk and Choices or Decision-making requirements. In fact some additional key words were noted as they fitted into the description of Design, Information and Action respectively. The complete list under each key-word is listed in Table 1.

The implications of this simple but revealing research exercise was that Design, Information and Action orientation are indeed important factors in entrepreneurial business venture context and appear consistently. By looking at the key words under Design for example we note the diversity and yet the consistency of meaning in a Design context. The same goes for the requirement of pertinent Information over a wide range of business venture aspects. Action was less representative (or less implied) as it is not a normal emphasis in academic papers.

IV. A PROPOSED MANAGEMENT MODEL

A. Background to the management model

With these insights as background a management framework based on the work of Winzker [7] [34] and Platzek [25], which was specifically developed for the high tech global environment, was adapted and related to managing technology in entrepreneurial business ventures. The original model was developed mainly for the high-tech environment, entrepreneurial or well established. It also caters for the turbulent, highly competitive globalised world and thus contains many of the Design, Information and Action characteristics or key words, as well as its intermediate dimensions. It is surmised that it could well apply to the entrepreneurial business venture.

For entrepreneurial business ventures to be successful, the interrelationships between the three key aspects Design, Information and Action provided a number of cascaded dimensions of interaction.

The model attempts to put the key-aspects and the dimensions of the interrelationships into a management framework. Such a management framework operates on fundamental strategic, operational / tactical and holistic levels which were called management literacies by Winzker [7]. The management literacies are easy to understand and must be applied in a concurrent, system thinking framework providing awareness in terms of the three key-aspects of the entrepreneurial space.

The nine management literacies with which the effective entrepreneur should be familiar if not be a superb master, are:

i) Future Management - where will the venture be positioned in the future, why would the entrepreneur want to be there and how to manage the path to that future state of the entrepreneurial venture
ii) Change Management – what must be changed to achieve the future state and how is that change managed
iii) Leadership and Vision – who is taking the lead, producing the action and promoting the Vision consistently by appropriate decision making, action and managing the resulting stress
iv) Knowledge management – the information already available, the information that must still be collected and the relevance of the knowledge base to the entrepreneurial venture
v) Innovation and Creativity – what specifically makes this entrepreneurial business venture unique, original and revolutionarily different and how will this be handled in terms of the management of innovation and the assessment of the potential risk
vi) Personal Mastery – The personal competencies, integrity, self-awareness, self-confidence with humility, inter- and intra-personal skills and functional / personal competencies, weaknesses and strengths are well known to the individual entrepreneur
vii) Ethics – what is the ethical value system of the entrepreneurial venture going to be and who lays it down

viii) Sustainability – are all the diverse factors such as financial, social, environmental sustainability parameters known, communicated and acted upon
ix) Value based management – does everything in the entrepreneurial business venture at every level, every process, by every involved person or stakeholder make a value contribution in the entrepreneurial business venture.

In the light of the above it should be clear that there are some critical attributes the technology management model for an entrepreneurial business venture has to deal with:

- Complete awareness of the total entrepreneurial business space in the broadest possible sense
- Understanding the purpose, potential risk of the venture
- The dependence of effective leadership and vision
- The characteristics of the dimensions alluded to above give insight into:
  - The temporal relevance, i.e. Time and *Zeitgeist*
  - the Entrepreneurial Business Space,
  - the integrated Systems Thinking Framework,
  - the actual Process which can contain a lot of evolutionary trial and error
  - Concurrency and Integration.
- A framework is required with which it is possible to capture the above in a rational manner, yet with a large degree of flexibility.
- Excellent and clear communication of a specific message commensurate with the purpose, risk and decisions that will be made by the entrepreneurial leader

If Design, Information and Action as discussed and motivated in the previous sections are to be integrated in a meaningful way in this model all the key words and intermediate dimensions must be addressed concurrently and with consideration for judicious decision making. It must also go hand in hand with massive, consistent action to push the entrepreneurial venture forward.

The proposed technology management model in the entrepreneurial venture lends itself to understand and judiciously manipulate the dynamics of the highly networked global business environment for sustained competitive advantage. The model recognizes and enables the manager and leader to address the many issues confronting them daily by giving a new strategic perspective with the help of sub-models. These sub-models form the anchors whereby a complex situation can be managed reasonably, effectively and hopefully with wisdom too. The management literacies articulated in detail provide an excellent framework for guidance and interaction and incorporate most of the Google-Search dimensions alluded to in the previous section where the DIA model has been introduced. It uses the term "literacies" very intentionally as the nine literacies are analogous to the ability to communicate in a language fluently, understandably and effectively. Nothing less is required by the Entrepreneur in the sense of mastery of the nine Management literacies.

The suggested model is to a large degree independent of time and the specific industry-space and is considered valid for a long time to come because it is guided by fundamental guidelines and not dogma. Again, in analogy to a language skill, an excellent command of say Chinese, enables us to articulate any topic in that language.

The management literacies developed are equally valid in other complexity-prone industries as can be confirmed by the authors' wide international practical experience in a number of industries, from Banking, Service provides, Health Systems, e-commerce, Petro-Chemical, Education and others. So it may not be exclusive to entrepreneurial endeavors but may be applied to more traditional enterprises with much success as well but this has still to be assessed in more detail in future research.

Sub-models on which the Management Literacies are built

The proposed entrepreneurial technology management model must recognize the following aspects concerning the larger business environment:

- The co-ordinates in time and space
- WHY: THE BELIEF SYSTEM
- HOW: The process of repeated review and re-adjustment if necessary
- WHAT: The context (may be the product or service of the venture
- Concurrency in terms of application in an integrated manner

Sinek [5] articulated the Golden Circle shown in Figure 3 to show why some (entrepreneurial) leaders inspire others and achieve a disproportionate degree of influence. It explains why the Wright Brothers and their dedicated team achieved greatness with their first motorised flight, why Dr Martin Luther King became such a respected leader of the Equal Rights Movement in the Sixties and why Apple is so disproportionately successful when compared to other computer manufacturers. The main reason is that Why refers to what the purpose, belief and cause of our actions are, what the company stands for and why others are attracted to us. This is a major aspect an entrepreneur and all business leaders should understand clearly. It is not What the company is designing, developing, manufacturing or trading nor is it about How wonderful the features are, it is about WHY the entrepreneurial business venture does what it does.

The Business Space reflects that change from time to time but also contains a stabilising element of choice due to strategic considerations and the specific industry of the high tech entrepreneurial business venture. In other words, the business space as defined by the entrepreneurial space of Figure 1 may be reasonably stable but the characteristics of that environment must be well understood.

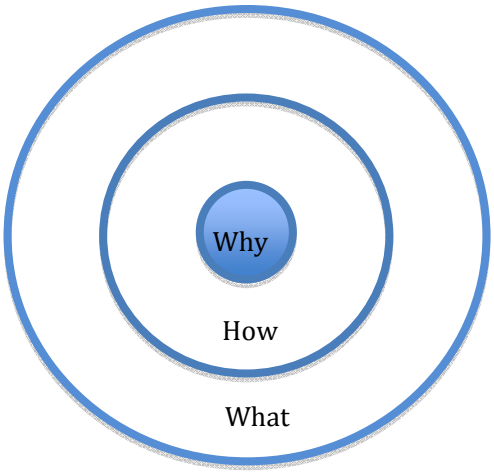

Figure 3: *Why we do something, How we do it and What it is that we are doing* is in the right sequence. Appealing to emotion, explaining the process and stating what the product, features and benefits entail, so well articulated by Sinek [5]

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The entrepreneur is subject to turbulences during all phases of the development of the business venture. Shake-free business due to the moving plates in the business environment is inconceivable. In all high tech companies the entrepreneur will be subject to major quakes. According to futurist Sweet [9] "*The question is whether or not the high tech business prepares for the shakes that will come wherever and whenever one operates in the business space and on the time-line. It is of paramount importance to be aware of the directions the tectonic forces are moving"*.

For the sake of synthesis and understanding, the proposed management model consists of a number of separate models that have to be exercised concurrently on a highly integrated basis. As we know from the Introduction section, the biggest problem is that there are no simple models for a complex world. If the model were a simple one, it could not handle the complexity and most of the really pertinent issues would be lost.

B. Description of the Technology Management Model for Entrepreneurial Business Ventures

The following nine management literacies by Winzker [7] have to be handled simultaneously and this is to be accomplished in a broad systems context, hence the term systems framework. A more detailed, alternative perspective of the nine literacies is given,

- **Future Management**
  This challenge considers aspects of vision, trends and scenarios which affect strategic leadership for a dynamic, complex and open system organisation operating in an open system environment. It is concerned with how the future is perceived, the place of the business within that future and how to manage the course to that future.
- **Management of Change**
  Managing change is one side of this challenge. But to initiate change and to help shape the future by means of effective implementation is the concurrent second challenge with regards to change. Furthermore the change –anticipated or current – has to be managed in a systems thinking context. Understanding and developing the change agent as an issue, system or person and identifying the most ideal change manager characteristics are just some high level considerations. Simultaneously initiating change and managing the resultant stress in the different aspects of a modern organization is a highly complex task and just complicated.
- **Leadership, Vision and Strategy**
  The challenge of appropriate and effective leadership conveying a vision which is conducive to the formulation and implementation of a tangible competitive strategy usually falls on the top management person. Such a person must articulate and promote a holistic, global and contemporary management and leadership concept, where leadership is multi-focused, institutionalized and where paradoxically leadership conforms to the attributes of "servant-leadership"; this mix of leadership attributes encourages experimenting, learning and coaching within a company culture of sustained value creation where people can experience sense and meaning for their own lives.
- **Know-how Management**
  Intellectual and proprietary knowledge have become highly significant in today's competitive globalized world. This is especially true in the high tech engineering field. Know-how has to be cultivated, protected and yet disseminated in a manner that allows a sustainable competitive advantage. Know-how management concerns the transfer of tacit knowledge to explicit knowledge so as to increase value creation in the company. It also concerns the transfer of that knowledge into tangible benefits for the end customer.
  Knowledge is based in people's heads and not so much in hard-drives and reports. As such it becomes a people issue even when discussing systems, processes and relationships. Production, finances, human resources, quality management, customer relations, marketing aspects as well as experiential knowledge of the individual will all fall into this elusive challenge.
- **Innovation and Creativity**
  This includes understanding and leveraging processes of innovation, utilizing employees' potential and appropriate knowledge application for the purpose of sustainable value creation. Innovation and creativity is closely related

to the company culture and the attributes of leadership in a catalytic sense. Innovation and creativity are characteristics of every person, even if it be to different degrees, but the promotion, unfolding and practical utilization of such innovation is a great challenge.

- **Personal Competencies and Personal Mastery**
  Defining and developing appropriate functional and interpersonal competencies in terms of the so-called softer skills is a challenge for every individual. Mature self-management and self-knowledge are preconditions for a balanced approach to a large variety of diverse and sometimes contradicting stress factors: intellect and intelligence, emotion, intuition, leadership characteristics, sensitivity to task and people, effective and appropriate communication, mentoring and facilitation competencies. These challenges have to be handled in a framework of finding personal meaning and balancing all aspects such as work, family, sport, cultural and spiritual activities.
- **Value-Based Management**
  Value-based Management ensures that every function and activity is evaluated in terms of the value-contribution it makes to some stakeholder of the organization. This periodic assessment is not done on the basis of some structured recipe-type process but is a self-assessment by the individuals with mentorship-support if and when required. It can be done through a formalized process which often consists of the financial parameters, but there are also many values which are not financial: customer delight, environmental issues, quality of life of the community, health, security and even media perception.
- **Ethics**
  Ethics and integrity covering all aspects of the business venture are essential. It includes dealing with issues and customers with integrity, social conscience and taking into account the sensitivities of various sub-groups of customers and society at large. Corruption, bribery treatment of human rights in the work situation etc have become most important aspects in the leadership of an entrepreneurial and conventional companies. It also includes honest and transparent business practices, articulation of a Code of Conduct as well as executing it daily in the entrepreneurial business arena.
- **Sustainability**
  Sustainability is a multi-faceted literacy comprising financial, social, environmental, ecological sustainability, to mention a few. Each of these aspects have to be considered judiciously and trade-offs have to be made. With interest groups such as animal rights, environmentalists and pacifists watching on social networks, the complete system picture must be considered at all times.

C. Schematic overview of the complete model with its sub-models

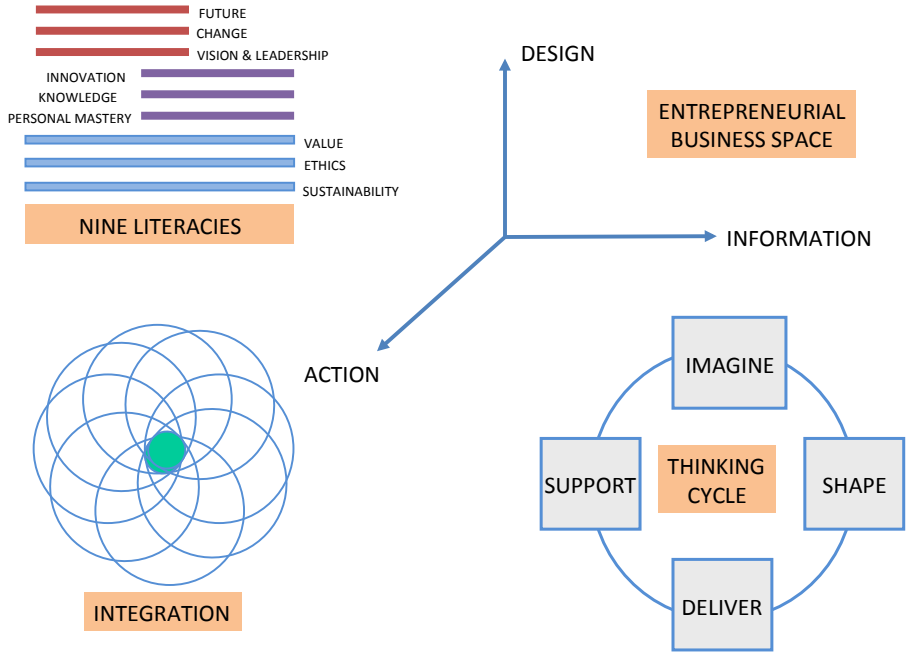

Figure 4: The complete Management Model with its sub-models according to Winzker [7]

Only if all nine challenges of the management model are considered by virtually everybody in the organisation under the leadership of the entrepreneur, in the sense of internalisation and personal commitment relevant to the level and position of the individual, and considered *concurrently* with an unbiased mix of rational and intuitive thinking, exceptional alertness and commitment, can the company be globally competitive in the long term.

The time dimension, the repeated cycle of review and the integration of all the key words and key aspects of Table 1 represent the important sub-models of Figure 4 that support the nine literacies

This may appear to be idealistic, but it is achievable when there is a relentless commitment in living it out daily, especially by example through the top-management team, the entrepreneur as the Action-Person. It is an on-going challenge fraught with highlights and pitfalls, with failures and recoveries. In the Entrepreneurial Venture it is dependent to a large degree on the single individual, the founder, owner, the entrepreneur.

It certainly strives for an ideal which will still be seldom enough achieved because

- life is messy and not everything can be formally integrated and considered concurrently,
- an organisation consists of flesh and blood fallible people who will not operate like automatons and
- totally unexpected twists and turns in the larger business environment will occur and upset the course of action, not to say the unpredictable universe of events when seen on a global scale.

All those who want to be entrepreneurial business leaders involved in a successful entrepreneurial venture have to be willing to let go or at least critically re-assess concepts such as continuity and consistency, because it is rooted in traditional power-base thinking, rigid hierarchical structures and related manipulation and control. Which is not necessarily wrong, rather it may be inappropriate for the times.

Over the past couple of years there has been a growing realization that norms and standards, long-cherished ideals and power-structures are crumbling [11], but it is not recognized as a natural and exciting evolution which is a consequence of the increasing interdependence of diverse technologies such as biotech, gene technology, robotics, IT, the Internet and the access to powerful computing technology.

The mind-set of many of those business leaders focuses on the power-structures, the hierarchical, the deterministic and validity of their traditional values. But the internet based entrepreneurial business world is evolving in contradiction to such thinking.

It is interesting to observe that the more powerful the organization in its particular industry in a traditional sense, the less likely that it will seriously notice the dynamics taking place all around them.

Of course, youthful enthusiasm, good intentions and a few additional management skills are insufficient to achieve a successful entrepreneurial business venture but four aspects receive new impetus, meaning and relevance during the transformation process:

- Evolutionary, Just-In-Case thinking makes a more effective contribution than detail planning
- Self-Organising and Self-Correcting counter-acts the effect of accelerated pace and the disorientation due to frequent change events
- Chaos can be constructive in such situations
- Multi-Perspective and even paradox provides a better picture of reality

The above indicates the importance of soft-factors and the emphasis to manage with innovative and imaginative flexibility in the transformation process. That innovative flexibility coupled to mature leadership will in turn cause better synchronization adapted to the vision of the company, better knowledge management and result in sustainable global competitiveness. In fact the quality of the leadership at all levels in the entrepreneurial business venture should determine the effectiveness of the business in terms of value-contribution, sustainability and global competitiveness.

V. THE OUTCOME AND PRELIMINARY RESULTS

The outcome and preliminary results of the exploratory research presented in this paper can be succinctly summarized as follows:

The identification of the key relationship between Design, Information and Action of Figure 1 using an exploratory research method provided a starting point to determine what can be done to handle the major dimensions the entrepreneurial leader is faced with in the fast moving digital era with more social network accountability and response to new breakthrough innovations. It looked at integration of the key words in the entrepreneurial business space Design, Information and Action and their intermediate dimensions Purpose, Risk and Decision-making and key words of Table 1.

All pertinent aspects that are listed as key words in Table 1 represent dimensions and key aspects used in academic literature as determined through a limited Google Scholar search.

The entrepreneur will have to move with energy, persuasiveness, agility, excellent information and make wise – judicious – decisions for the business venture to provide smart designs that compel through purpose, low risk, sustainability and ethical operations.

So as to enable the entrepreneur to navigate the multi-disciplinary turbulent scenario requires different and new management tools. System thinking is nothing new in this regard but now the systems approach as determined deductively at least from the literature review must reside in a

bundle of literacies which will enable the entrepreneurial venture business to initiate excellent design with consideration of relevant and accurate information so as to take decisive and accurate action.

The ability to integrate a large variety of aspects, dimensions, disciplines and skills concurrently is a seemingly difficult process. However today's entrepreneurial leaders must engage at this level and intensity consistently and honestly if success is to be a sought-after outcome.

VI. PRACTICAL IMPLEMENTATION AND FUTURE RESEARCH

Three organisations with whom the authors have some relationship and dealings are being assessed in the meantime on account of their "entrepreneurial" paradigm by means of the key-aspects and dimensions, and measured against the dimensions and their self-assessed command of the nine management literacies of the model. This forms part of ongoing future research on the topic presented in this paper.

The companies under consideration are:

Apple Inc, USA – well known to all

Weber Instrumente, Germany – design, manufacturing and international sales of surgical instruments

BEMER Physical Vascular Therapy Medical Device, Liechtenstein – R&D, design, manufacturing, international distribution.

The formal results for this assessment will form part of future research and these will be presented only in a future research paper.

VII. CONCLUSION AND DISCUSSION

The proposed management model for the Entrepreneurial Business Venture established in this paper using an exploratory research approach is deemed very suitable due to a) the multitude of interdependent parameters that have to be considered concurrently and repeatedly, b) due to the many causalities involved and c) many of which are not always apparent, but rather concealed.

The important key-aspects identified for Entrepreneurship, namely Design, Information and Action are catered for in the management literacies and the sub-models pertaining to the time (Zeitgeist), level and appropriateness of the technology and the specific industry environment. The consistent application and promotion of these literacies form the foundation on which the Entrepreneur can develop their business venture successfully. A mature and disciplined, yet not rigid, approach represents a new paradigm in the effective management and leadership of such entrepreneurial organisations. The management model is closer in attributes to a mind-set, than to a procedure.

Paradoxically, the framework of sub-models of course also resembles a structural approach by its very definition, but in application it relies on dynamic relationship behaviour and continuous assessment between the various aspects under consideration rather than functional and sequential interactions.

The management model relies on the intimate, intense and dynamic relationship of the high tech company (personnel, systems and processes) with its larger environment (all stakeholders and shifting circumstances) embedded in a mental model given by the framework of sub-models, characterised by the wisdom, talent and skill of the leader or collective leadership of top-management. It also recognises the importance of the time frame and Zeitgeist in which the high technology company must function in a healthy, i.e. effective and efficient, manner.

Likewise, the nine core management literacies provide the anchors for the business' orientation. These nine literacies incorporate all relevant aspects of strategic and operational importance for the company whilst providing an economic return, keeping sustainability and ethics in check.

The holistic business parameters as another sub-model point to those parameters that have been shown to form a value chain for a healthy organisation [7] [34]. By addressing each parameter in the nine literacies as a matrix approach with appropriate knowledge, insight and wisdom the business can grow, develop and prosper.

The repeated re-visiting of all identified aspects and parameters on a regular basis is mandated by the shifting trends in the business environment, including economics, technology and processes. The judicious application of the sub-model *Imagine – Shape – Deliver – Support* thus ensures a careful examination of assumptions and observations in real time.

The important questions posed by Sinek [5] in the right sequence of *Why* we are in this business, *How* do we do what we do and *What* is it that we hope to produce in the Entrepreneurial Business Venture in a competitive manner are incorporated in the nine literacies management model as well.

Finally all these considerations, reflections and actions have to happen concurrently and, ideally, at the Sweet Spot of the entrepreneurial leaders' perceived talent, competency and wisdom. Only then will the model provide a sustainable means to continuously transform high technology entrepreneurial companies into sustainable globally competitive and healthy businesses.

The future research envisaged may include further empirical investigations to evaluate the model in some more detail as referred to in the previous section.

REFERENCES

[1] Gerber, Michael E; *Awakening the Entrepreneur within*, Harper Collins, New York, 2008

[2] Crainer, Stuart; Dearlove, Des; *Generation Entrepreneur*, Pearson Education, London, 2000

[3] Schmidt, Eric; Cohen, Jared; *The New Digital Age*, John Murray Publ, London, 2013

[4] Parkin, Godfrey; *Doing Business Digitally*, Zebra Press, Cape Town, 2008
[5] Sinek, Simon; *Start with Why,* Penguin, Kindle Book
[6] Peters, Tom; *Re-Imagine*, Dorling Kindersley Books, UK, 2003
[7] Winzker, Dietmar H, *Holistic Engineering & Technology Management*, PhD Thesis, 2005
[8] Ulrich, Eppinger; *Product Design and Development,* McGraw-Hill, Singapore, 1995
[9] Sweet, Leonard, *Soul Tsunami: Sink or Swim in the Millennium Culture*, Zondervan Publishing House, 1999
[10] Grulke, Wolfgang, *Lessons in Radical Innovation*, atonecommunication, 2001
[11] The Economist; www.economistinsight.com and www.eiu.com
[12] Platzek, Bernd; *The Role of Intrapreneurship in a Globally Competitive Technology Business Environment*, PhD Thesis, 2012
[13] von Stamm, Bettina; *Managing Innovation, Design and Creativity,* John Willey, 2nd Edition, 2008
[14] Tidd, Joe and Bessant, John; *Managing Innovation*, John Wiley & Sons, Chichester, England, 2009
[15] Carayannis, Elias G; *Fostering synergies between Information Technology and managerial and organisational cognition: the role of knowledge management,* Technovation - Pergamon 19 (1999) 219-231
[16] Deeds, David L; *The role of R&D intensity, technical development and absorptive capacity in creating entrepreneurial wealth in high-technology start-ups,* J.Eng. Technology Management 18 (2001) 29-47
[17] Fendt J, Kaminska-Labbe, R; *Relevance and creativity through design-driven action research: Introducing pragmatic adequacy,* European Management Journal 29 (2011) 217-233
[18] Johannessen,J, et al; *Mismanagement of tacit knowledge: the importance of tacit knowledge, the danger of information technology and what to do about it,* Int'l J. Information Management (Pergamon) 21 (2001) 3-20
[19] Yap, C, Souder Wm E; *Factors influencing New Product Success and Failure in Small Entrepreneurial High-Technology Electronics Firms,* J. Product Innovation Management 11 (1994) 418-432
[20] Ottosson, S; *Participation Action Research – A key to improved knowledge of management,* Technovation - Pergamon 23 (2003) 87-94
[21] Senge, Peter; *The Fifth Discipline*, Century Business, Random House UK, 1990
[22] Vester, F; *Die Kunst vernetzt zu denken*, Deutsche Verlags Anstalt, Stuttgart, 1999
[23] Steyn, H; *Design and Entrepreneurship,* Multimedia Access, Pretoria, SA, 2008
[24] Platzek, B., Pretorius, L., Winzker, D; *A role model for entrepreneurial firms in a global business environment,* VGTU Publishing House Technika, Vilnius, 2010
[25] Platzek, B., Pretorius, L., Winzker, D; *Global business environment: Holistic entrepreneurship,* SCMS J. Indian Management, Cochin, 2011
[26] Platzek, B., Pretorius, L., Winzker, D; *Identifying and pursuing business opportunities in a vital entrepreneurial learning organisation,* ISEM Proceedings, Stellenbosch, SA, 2011
[27] Platzek, B., Pretorius, L., Winzker, D; *Sustainability in technology driven business environments : a company-level approach,* PICMET'12 Proceedings, IEEE, Portland, Ore, USA, 2012
[28] Porter, M; *Competitive Advantage of Nations,* MacMillan Press, London, 1990
[30] Koe, W-L, Majid, ; *A Model for Predicting Intention towards sustainable entrepreneurship,* Int'l J of Information, Business and Management, Vol6, Nr 2, 261-268, 2014
[31] Neck H, Green P; *Entrepreneurial Education: Known worlds and New Frontiers,* J of Small Business Management, Vol 49, 55-70, 2011
[32] De Geus, A; *The Living Company,* Nicholas Brealey Publishing, 1997
[33] Andersson, S*; "International entrepreneurship, born globals and the theory of effectuation"*, Journal of Small Business and Enterprise Development, Vol. 18 Iss: 3, pp.627 – 643, 2011
[34] Winzker D, Pretorius L; *Technology and Engineering Management in a Fast Changing World: Creating Substance out of Chaos",* PICMET '09 Proceedings, Portland Ore, USA 2009
[35] Winzker D, Pretorius, L; *Developing and Implementing Strategic Intent in a Post-Modern World,* IEMC Proceedings, Paper Nr 197, St Johns, NFL, Canada 2005
[36] Winzker D, *Personal Correspondence with diverse Entrepreneurs,* 1995 to 2013
[37] Wired Magazine, UK Edition; *"How to Innovate",* Special Issue Oct 2013
[38] Wired Magazine, USA Edition; *"Why wearable tech will be as big as the smartphone",* Issue Jan 2014
[39] Entrepreneur Media SA, Entrepreneur Magazine, *"Break all the Rules, overcome challenges, turn crazy ideas into millions",* Issue Dec 2012