A Methodology for Ranking Incubators Using Composite Indicator

Ghasem Moslehi,[1, 2] Hamid Mahdavi[2], Morteza Rasti Barzoki[2]
1. Isfahan University of Technology, 2. Isfahan Science and Technology Town - Iran

Abstract

Incubators have gained wide reputation in most countries as efficient institutions contributing to regional development and economic growth. They assist their clients through their value-adding services and a wide range of support services and facilities that cannot be easily procured from other sources. The content of these services and the way they are supplied will have important effects on the success of the incubatees, and thereby, on the incubators' performance. Introducing improved incubation models, informing incubators of their distance from acceptable performance norms and models, and disseminating incubators' success stories among those involved in the industry will be tools that are expected to assist incubator managers to make more informed and enlightened decisions.

The use of composite indicators is a simple method of comparing a wide variety of systems under evaluation such as countries and organizations dealing with a multitude of complicated and wide issues including environmental, economic, social, and technological. Normally, the main objective in defining composite indicators is to compare the performance of a group of subjects evaluated along a given dimension. These indicators can also function as useful tools in analyzing policies and in communication of information to the public. In this paper, first, a state-of-the-art account of constructing composite indicators will be presented and then a number of tentative composite indicators will be introduced. Special emphasis will be laid on key performance indicators used in ranking technology incubators with due regard to the Iranian business incubation environment. This study is the first of its kind and is expected to open new avenues to taking effective measures in improving business and technology incubation programs.

Keywords: Incubator, Composite index, AHP, Index

1. Introduction

Around half a century has passed since the first business incubator was established in 1959 in Batavia, New York [1], but the thousands of incubators now operating across the globe have emerged and developed only during the last three decades. All along these years, great efforts have been made to define and classify incubators. Albert and Gaynor (2001) carried out a useful survey of about 200 studies performed on the various aspects of incubators [2]. Hakett and Dilts (2004) also performed a systematic review of studies dealing with the five areas of incubator development, incubator configuration, incubatee development, incubator-incubatee impacts, and the theoretical issues differentiating incubator from incubation [3]. The definitions and classifications so far provided for incubators as reported in References (2) and (3) are presented in Appendix. From among them, the definition by NBIA of a business incubator goes as follows:

"Business incubation is a dynamic process of business enterprise development. Incubators nurture young firms, helping them to survive and grow during the start-up period when they are most vulnerable. Incubators provide hands-on management assistance, access to financing and orchestrated exposure to critical business or technical support services. Most also offer entrepreneurial firms shared office services, access to equipment, flexible leases and expandable space — all under one roof. An incubation program's main goal is to produce successful graduates — businesses that are financially viable and freestanding when they leave the incubator, usually in two to three years [4].

One aspect whose importance becomes increasingly evident after the initial stages of organizational development is the need for monitoring, evaluation, and measurement of the organizational status and performance. As in all other organizations, incubators also need to have a systematic business plan in place that must be executed, evaluated, and changed strategically at all decision-making levels. When properly accomplished, these processes will introduce constant changes along the lines of organizational objectives. It is, therefore, essential to have plans and systems that provide information about the performance of the organization. Studies on performance measurement can be considered from two aspects: Organizational theory and Strategic management [5]. The three fundamental approaches from organizational theory are: the goal-based approach [6], the systems approach [7], and the multiple constituencies approach [8]. Incubators are typically evaluated according to the achievement of their goals [9].

The first studies on incubation program evaluation were carried out in the late 1980s and include Campbell and Allen [10], Allen and Weinberg [11], and Campbell [12], who studied a number of factors such as number of jobs created and the failure and success rates of incubated enterprises [13,14]. The first attempt for a cost-benefit assessment of incubators is due to Thomas Lyons [15] who carried out his study in the State of Michigan in 1990. This was followed by Mark Rice's [16] PhD dissertation in 1992 [13]. Peter Bearse developed a comprehensive set of procedures on incubator evaluation in which special emphasis was laid on the necessity for a systematic multi-criteria evaluation system [17]. Albert and Gaynor classified all the studies performed in the field along the following lines [2]:

- Studies involving the development of measures to assess incubation programs;
- Quantification of incubator impacts on SMEs and the local economy;
- Ranking of future incubation programs; and
- Impact assessment of incubation programs.

Bhabra Remedios and Cornelius (2003) reviewed the studies conducted on incubator definition and came to the conclusion that no comprehensive framework yet existed for the evaluation of incubators [18]. More recently, however, a number of efforts have been made to develop incubator benchmarks. Examples of these efforts include Tornatzky *et al* (2001) [19], European Commission and the Centre for Strategy and Evaluation Services [20], and UKBI (2003) [21]. The Danish National Agency for Enterprise and Construction published a report entitled "Benchmarking Incubators" in 2004 in which the performance of 19 incubators had been compared along seven dimensions; namely, degree of specialization, strategic counseling, monitoring, outreach, financing, and networks and cooperation with knowledge institutions [22]. The report measured the incubators' performance through aggregation (weight sums) of the two indicators of 'exit rate' and 'foreign investment' to classify incubators into better-performing and lower-performing incubators. The results from this report indicate that incubators with best performance concentrated a lot on specialization and networking with local communities and, compared to the lower-performing incubators, relied less on formal monitoring and strategic counseling. Meanwhile, they found no significant differences between the low-performing and top-performing incubators with regard to financing, cooperation with universities, and outreach. Benchmark analysis offers an opportunity for the evaluation of the positive relationship between a certain business sector and the overall incubator performance. However, benchmarks fail to detect the causal relations and the way different factors affect incubator performance [22].

One way of gaining knowledge about the performance of an organization and its procedures is to have structured and consistent performance information systems represented as composite indicators. These are indeed the core substance of a system's traits, events in its history, and the outcomes of those events expressed in the form of simple and short messages to policy-makers and the public; thus, indicators serve as a strong communication bridge between these two groups in the community. Composite indicators can render complex and multi-faceted issues into simple expressions for policy-makers and the public alike. Along these lines, indicators representing a detailed progress towards predefined objectives can serve as useful tools for the assessment of policies made and activities performed. Composite indicators, aggregated from constituent indicators through mathematical

methods, represent one dimension of the system performance. These composite indicators have found vast theoretical and practical applications. For a summary on certain composite indicators, Ref. [23] may be consulted. Typically, the objective in developing composite indicators is to rank a set of evaluated references according to one property. According to a report published by UN on human resource development index, "… index can be better than the data it uses. But this is an argument for improving the data, not abandoning the index."

The growing interest in employing composite indicators is basically due to increased complexity of policy-making problems and the large amount of data to be handled. In summary, proper index development, which is more of an intra-systemic concern, contains the past performance history, reform trends, and improvements while the system developed can also be used as a tool for evaluation and measurement of success over time as well as prediction of detailed future conditions of the system. Development of composite indicators, which is of extra-systemic importance, is a tool for measuring the situation of every system within scope, as well as for comparing and ranking them. Reducing data masses, facilitating communication, and increasing accountability and responsiveness are distinctive characteristics of composite indicators. As with benchmarks, composite indicators are capable of identifying the performance of different models through detecting top-performing and low-performing incubators. What is important about composite indicators is their proper development since lack of expertise and experience in constructing CIs may lead to defective and misleading information. As mentioned earlier, incubators are of as many types as there are objectives behind them; it, therefore, follows that comparison of incubators must be accomplished in independent groups and on the basis of their types; hence, for each incubator type a different set of composite indicators must be formulated. According to Ref [22] "… in some cases it may be beneficial to isolate and compare specific groups of incubators with similar goals."

From the above considerations, it follows that classification of incubators against composite indicators is necessary for their ranking. As mentioned earlier, the Appendix contains definitions and classifications of incubators as surveyed by Albert and Gaynor [2] and Hackett and Dilts [3]. In addition to these, OECD (1997) has also used the major objectives of incubators and the characteristics of their tenants to classify them into the following three categories [24]:

- General/Mixed-Use Incubators are mainly committed to promoting continuous regional, industrial and economic growth through general business development;
- Economic Development Incubators are business incubators whose main aim is to stimulate specific economic objectives such as job creation and industrial restructuring, often the result of local government initiatives;
- Technology Incubators are incubators whose primary goal is to promote the development of technology-based firms, as spin-offs from universities and science parks, in order to promote technology transfer while encouraging entrepreneurship among researchers and academics.
  Iranian incubators may be classified with the third category.

In the light of what went above, it will be essential for policy-makers to develop and employ composite indicators in their attempts to gain knowledge about the performance of organizations under their leadership, to make enlightened decisions and to raise awareness among organizations through such encouragements and rewards as announcing the rankings of organizations in order to boost competition among peers. Reviewing the most recent trends in building composite indicators, the present paper will also introduce a number of important composite indicators developed in this study for technology incubators. The paper will conclude with a number of recommendations and suggestions. It is hoped that the issues raised here will instigate further research at both national and international levels aimed at developing an exhaustive set of composite indicators to be used in evaluating and ranking business/technology incubators.

2. Methodology for developing composite indicators

In very simple terms, a composite indicator is the aggregation of a set of other atomic indices (sub-indicators). There are a number of definitions proposed for a composite indicator but the one given by

Nardo *et al* [25], which is similar to the one proposed by Saisana and Tarantola (2002), goes as follows [26]:

'A composite indicator is the mathematical aggregation of individual indicators that represent different dimensions of a concept whose description is the objective of the analyses.

A different version by the Counseling Meeting of the European Committee in 2002 (Brussels) runs as follows [27]:

'Composite indicators are based on sub-indicators that have no common meaningful unit of measurement and there is no obvious way of weighting these sub-indicators'.

Composite indicators have won the attention of most statesmen and useful techniques have been proposed by researchers for all the stages of their development. According to Nardo et al, "… composite indicators are a way of distilling reality into a manageable form." [25].

	Composite indicator	**Objective**
1	Access to technology	Measuring creation and dissemination of technology and human resource development
2	Job creation	Qualitative and quantitative improvements in job creation
3	Financial	Wealth generation and economic development

Table 1. Three important composite indicators for ranking incubators

'The Handbook on Constructing Composite Indicators: Methodology and User Guide' summarizes the construction of composite indicators in the following steps [28]:

1. *Developing a theoretical framework*: Proper development of a composite indicator requires a clear conceptual model of the phenomenon to be measured and the way the measurement should be accomplished. This is the stage that determines all the methods and procedures to be employed in the later stages of indicator development
2. *Selecting variables*: Selection of indicators calls for the skills of experienced and open-minded experts as there is no systematic method that can be used in selecting a specific indicator relevant to a given phenomenon. However, the strength of a composite indicator depends to a large extent on the simple atomic indicators selected.
3. *Multivariate analysis*: Arbitrary selection of sub-indicators mixed with a bit of carelessness in detecting viable relationships among them will result in misleading policy-makers and the public. Data analysis prior to developing composite indicators will, therefore, be necessary. Multivariate analysis is a powerful tool that can be exploited to achieve this objective through evaluation of stability in datasets and by providing an understanding of how the construction methodology must be selected. Along these lines, FA and RIA methods can be used for data set grouping and the CA method for references under evaluation.
4. *Imputation of missing data*: Three general approaches can be taken in cases where the required data are missing: truncation, single-imputation (such as mean, mode, median, regression, and time series methods), and multiple-imputation (such as Markov Chain Monte Carlo Simulations).
5. *Normalization of data*: Since datasets do not share similar scale, it will be necessary to transform them to the same scale. There are various methods available for data normalization, the most important of which are: weighting, standardization, descaling, distance to a reference point, and categorical scale of periodic indicators among others. The selection of a suitable normalization method to apply to the problem at hand is not trivial and deserves special care. This is usually affected by characteristics of the datasets and the objective of the composite indicator.
6. *Weighting and aggregation*: Indicators will be assigned different weights in order to reflect their significance, statistical adequacy, cyclical conformity, speed of available data, etc.

Various techniques exist for weighting indicators which can be generally grouped into two categories: weights based on statistical models (such as DEA, FAS, and UC models) and conjoint analysis (such as budget allocation and AHP).

According to Forman *et al* (1983) [29]: "AHP is a compensatory decision methodology because alternatives that are efficient with respect to one or more objectives can compensate by their performance with respect to other objectives. AHP allows for the application of data, experience, insight, and intuition in a logical and thorough way within a hierarchy as a whole. In particular, AHP as a weighting method enables decision-makers to derive weights as opposed to arbitrarily assign them."

Given the advantages of Group Decision AHP, it is recommended for use in computing indicator weight. Below is a brief description of this method. Aggregation of indicators to derive a composite indicator is also accomplished in this same stage, for which a number of methods can be used including additive methods (such as linear aggregation), the product of indicators (such as geometric aggregation), and nonlinear methods (Multi-criteria Analysis). Each of these methods has its own assumptions and results.

6.1. Group AHP:

AHP, first proposed by Saaty (1986), is a multi-criteria decision-making technique with the widest applications. According to this technique, Saaty's pair comparison method is used in computing weights at all levels. Using the group AHP, decision-makers are asked to determine their preference for an item *i* over another item *j* by assigning numbers from 1 to 9 as represented in Table (1). Ultimately, the weight of each indicator will obtain according to the following algorithm.

Let us assume the following designations:

D_k: k^{th} decision-maker ($k=1, \ldots, N$)

a^k_{ij}: preference of an item (indicator) i over another item (indicator) j by the kth decision-maker

wi: weight assigned to item (indicator) i

Ak: Matrix of pair comparisons of items by the kth decision-maker Ak = (ak ij)n*n

n: Number of items (here the number of indicators in each composite indicator)

aij: Preference of item i over item (indicator) j.

A: Matrix of pair comparisons of items (indicators).

1	Equally preferred
2	Equally to moderately preferred
3	Moderately preferred
4	Moderately to strongly preferred
5	Strongly preferred
6	Strongly to very strongly preferred
7	Very strongly preferred
8	Very strongly to extremely preferred
9	Extremely preferred

Table 2. Definitions of pair comparison values

Group *AHP algorithm for computing indicator weights:*

I. Matrix A_k filled out by each decision-maker;

II. Initial computation of the weight of each item by the decision-maker to consider the compatibility of pair comparisons. Computation of the weight of items can be accomplished in a number of ways, the most widely known and the most widely used being the special vector method. Steps to be taken in this method are:

- Developing the A_k - λ_i matrix;
- Computation of the determinant equation of the A_k - λ_i matrix and obtaining the determinant roots;
- Computation of weights (w_i) using the relation $(A_k - \lambda_{maxi})*W = 0$ in which λ_{max} is the highest value of λ as computed in the previous step. In cases where the matrix dimensions are very large, the problem can be solved using computer, numerical, or other methods available.

III. Computation of the incompatibility index of the matrix using the equation $I.I. = \frac{\lambda_{\max} - n}{n-1}$; incompatibility rates $(\frac{I.I.}{I.I.R})$ of smaller or equal to 0.1 are acceptable, otherwise the matrix A_k must be inspected for each decision-maker. I.I.R is a stochastic matrix incompatibility index obtained from Table (3)

N	2	3	4	5	6	7	8
I.I.R	0	0.58	0.9	1.12	1.24	1.32	1.41

Table 3. Stochastic matrix incompatibility index

IV. Computing the geometric mean of preferences in the form of $a_{ij} = \left(\prod_{k}^{N} a_{ij}^{k} \right)^{\frac{1}{N}}$, developing the matrix A, and reiteration of the procedures in step 2 in order to obtain the relevant weights.

7. *Robustness and sensitivity*: Use must be made of two essential tools in order to examine the quality of indicators and to evaluate the reliability of the ranking and the results obtained during the development of composite indicators including data selection, data quality, data revision, data normalization, weighting system, and data aggregation. UA focuses on the impact of the uncertainty of input factors on the composite indicator and SA concentrates on the value of output variance due to sources of uncertainty.
8. *Links to other variable*: Correlations between indicators and other indicators must be established using regressions in order to evaluate the power and accuracy of a composite indicator. For example, the access to higher technology entails increased per capita income. Therefore, this correlation can be used as a tool in the evaluation of the values of the indicator and in finding potential methods of improving upon them.
9. *Back to detail*: After the composite indicator is computed, a closer concentration on the constituent indicators in a composite indicator can reveal the weaknesses and strengths of the system in a certain area. It must also be borne in mind that any increase in one composite indicator does not necessarily mean improvement in all its constituent indicators.
10. *Presentation and dissemination*: Depending on the user, the presentation of a composite indicator may vary from simple forms (e.g. charts and tables) to more complex formats (such as the square model).

3. Three important composite indicators:

Table (4) presents three of the most important composite indicators along with their constituent indicators proposed for ranking Iranian business incubators.

Composite indicator	Category	Constituent indicators
Access to technology	Development of Technology	Per capita national patents
		Per capita international patents
		Income for licensing or royalties of patents
		Income from commercialization of patents (number of contracts)
		Survival rate
	Technology dissemination	Per capita web sites
		Technology transfer/exports
	Human skills	Average education
Financial	Enterprises	Average cash flow
		Foreign/external investments attracted
	BIs	Mean capital investment in establishing new enterprises
		Mean capital costs for creating each job
	Government	Percentage of government income
Job creation	Quantity	Nominal number of jobs created
		Actual number of jobs created
	Quality	No. of hi-tech jobs
		No. of mid-tech jobs

Table 4. Three composite indicators proposed for Iranian incubators

4. Conclusion

Although ages has passed since the emergence of the first incubator, evaluation and measurement of their performance, especially in the Iranian business environment, must be the focus of attention by policy-makers more than ever before. A common method of measuring organizational performance is to use composite indicators in detecting variation trends, in ranking organizations, and in gaining enlightened awareness of their status in their operating environment and as compared to peer organizations. This paper attempted to explain a state-of-the-art methodology for the construction of composite indicators. A number of tentative composite incubators relevant to technology incubators were also proposed as an attempt to define a framework for ranking the incubators operating in Iran. The methodology defined here is expected to serve as a pioneering effort in ranking incubators and incubation programs. It is proposed that in the next stage, the proposed methodology and composite indicators should be employed in evaluating incubators.

Appendix

Albert et al (1986)	An enterprise incubator is a 'collective and temporary place for accommodating companies which offers space, assistance and services suited to the needs of companies being launched or recently founded. An enterprise incubator has four principle characteristics: 1) the availability of modular and expandable space to rent for a limited period, 2) access to shared cost services relating principally to administrative functions, 3) access to management or technological support as well as privileged access to business and scientific communities and 4) a place for interaction between companies and for moral support coordinated by the management team. '
Smilor and Gill (1986)	'A technology-incubating program is an innovative system designed to assist entrepreneurs in the development of new technology-based firms, both start-ups and fledglings. It seeks to effectively link talent, technology, capital and know-how to leverage entrepreneurial talent in order to accelerate the development of new companies, and thus speed the commercialization of technology.'
Allen and Bazan (1990)	An incubator is a 'network or organization providing skills, knowledge and motivation, real estate experience, provision of business and shared services'
Allen and McCluskey (1990)	An incubator is 'a facility that provides affordable space, shared office services and business development assistance in an environment conducive to new venture creation survival and early stage growth'
Duff (1994).	'A business incubator may be defined as an organisation which offers a range of business development services and access to small space on flexible terms, to meet the needs of new firms. The package of services offered by a business incubator is designed to enhance the success and growth rates of new enterprises thus maximizing their impact on economic development... A business incubator consists of 5 dimensions namely enterprise development, a consultancy network, entrepreneurial synergy, flexible space and shared services'.
Tornatzky et al. (1996).	'A technology business incubator give the investor/entrepreneur the place and time to develop the product, as well as access to skills and tools needed to create a successful business'.
Lyons, Lichtenstein and Chhatre (1996)	'Programs to assist in the formation, development and survival of new enterprises.'
Kumar and Kumar (1997)	'The process of incubation refers to a set of activities designed to facilitate new firm formation via entrepreneurship and technology transfer.'
Sherman and Chappell (1998)	'Business incubators accelerate the successful development of entrepreneurial companies'
Sherman and Chappell (1998)	'Business incubation is an economic development tool primarily designed to help create and grow new businesses in a community. Business incubators help emerging businesses by providing various support services, such as assistance in developing business and marketing plans, building management teams, obtaining capital and access to a range of other more specialized professional services. The also provide flexible space, shared equipment and administrative services...'
Sherman (1998)	'Technology incubators foster the growth of firms involved in emerging technology. Many of these incubators are associated with major universities and have as a primary objective commercializing technology.'
Shahidi (1998)	'Business incubators are public, private or university sponsored business assistance organizations whose purpose is to support the development and growth of new enterprises through the provision of a variety of services'
Hansen et al (2000)	'.(An incubator is)...any organization that helps start-ups develop in an accelerated fashion by providing them with a bundle of services, such as physical space, capital, coaching, common services and networking connections.'
(Rice, 2002)	'Business incubators . . . nurture and grow start-ups in the Internet economy. They offer fledgling companies . . . office space, funding, and basic services such as recruiting, accounting, and legal—usually in exchange for equity stakes.'

Definitions of incubation (Source [2, 3])

Allen (1985)	Public Private University
Campbell, Kendrick, Samuelson (1985)	Industrial University Private Office Space Private Sector
Smilor (1987)	University related Private Community Corporate Franchise
Allen And Mccluskey (1990)	For Profit Property Development Non-Profit Development Corporation Academic For-Profit Seed Capital
Rice And Matthews (1995)	Property Model Property/Services Model Venture Capital Model
Sherman And Chappell (1998)	Mixed Use Manufacturing Technology Service Micro-enterprise / empowerment
Sherman (1999)	Mixed Use Technology Empowerment
Lalkaka (2000)	**Incubator Sponsor** University/Research Organization Public Private Partnership Private Sector Initiative Venture Capital Based **Incubator Type** Technology Park also known as Science Park (UK), Research Park (US) and Tecnopole (France) Innovation Centre also known as Business Incubator (US), Technology and Innovation Centre (Germany), Business and Innovation Centre (Europe) **Incubation System** Tecnopole Science Park Business Park Industrial Park Business and Innovation Centre Technology Centre Managed Workshop Innovation Centre Enterprise Centre (Incubator without walls)
Albert, Philippe. (2000)	Incubators for local development Real Estate incubators Entrepreneurial incubators Strategic incubators Financial incubators
Aernoudt Of The European Commission.	Mixed Economic development Technology Social Basic research
Aragon And Landry, Red Herring (2001)	Open commercial technology incubators Not-for-profit industry clusters Corporate incubators University/Government incubators Private commercial technology incubators Venture capital firms

Classifications of incubators by different researchers (source [2])

References

1. Brown M., Harrell M.P., Regner W. Internet Incubators: How to invest in the new economy without becoming as investment company , Business Lawyer, 56(1): 273-284, 2000.
2. Albert, P., Gaynor, L., Incubators: growing up, moving out - a review of the literature, Cahiers de Recherche, Arpent. 2001.
3. Sean M. Hackett. David M. Dilts. A Systematic Review of Business Incubation Research, Journal of Technology Transfer, 29, 55–82, 2004.
4. NBIA (2004), website: www.nbia.org.
5. Murphy, G.B., Trailer, J.W., Hill, R.C. Measuring Performance in Entrepreneurship Research, Journal of Business Research, 36: 15-23 1996.
6. Etzioni, A. Modern Organisations, Prentice-Hall, Englewood Cliffs, NJ 1964.
7. Georgopolous, B.S. & Tannenbaum, A.S. The Study of Organizational Effectiveness, American Sociological Review, 22: 534-540, 1957.
8. Thompson, J.D., Organizations in Action, McGraw Hill, New York, 1967.
9. Bearse, P. A question of Evaluation: NBIA's Assessment of Business Incubators, Economic Development Quarterly, 12(4): 322-333, 1998.
10. Campbell, C, Berge D. Janus J. and Olsen K. Change agents in the new economy: Business incubators and economic development, Hubert Humphrey Institute of Public Affairs, Minneapolis, 1988.
11. Allen, D.N. and M.L. Weinberg, 'State Investment in Business Incubators,' Public Administration Quarterly 12 (2), 196–215 1988.
12. Campbell, C, Berge D. Janus J. and Olsen K. Change agents in the new economy: Business incubators and economic development, Hubert Humphrey Institute of Public Affairs, Minneapolis, 1988.
13. Lalkaka, R. and Shaffer, D. 'Nurturing Entrepreneurs, Creating Enterprises: Technology Business Incubation in Brazil', International Labour Organisation, 1998.
14. Lalkaka, R. Assessing the Performance and Sustainability Of Technology Business Incubators, International Centre for Science & High Technology, Trieste, Italy. 4 – 6 December 2000.
15. Lyons T., 'Birthing Economic Development: How Effective are Michigan's Business Incubators' Center for the Redevelopment of Industrialised States, Social Science Research Bureau, Michigan State University 1990.
16. Rice, Mark 'Intervention Mechanisms Used to Influence the Critical Success Factors of New Ventures: An Exploratory Study', Centre for Entrepreneurship of New Technological Ventures, Rensselaer Polytechnic Institute, Troy, New York, 1992.
17. Bearse, P. The Evaluation of Business Incubation Projects: A Comprehensive Manual. Athens, Ohio: National Business Incubation Association, 1993.
18. Bhabra-Remedios R.K., Cornelius B. 'Cracks in the Egg: improving performance measures in business incubator research A paper for the Small Enterprise Association of Australia and New Zealand 16th annual Conference, Ballarat, 28 Sept-1 Oct, 2003.

19. Louis Tornatzky, Hugh Sherman, Dinah Adkins, A National benchmarking Analysis of Technology Business Incubator Performance and Practices, Report to the Technology Administration, U.S. Department of Commerce, 2002.
20. Benchmarking of Incubators. Final Report, European Commission and the Centre for Strategy and Evaluation Services 2002
21. Benchmarking Framework for Business Incubation final Report, UKBI, 2003.
22. National Agency for Enterprise and Construction, 2004.
23. State-of-the-Art Report on Composite Indicators for the Knowledge-based Economy, Workpackage 5, European Commission-JRC, 2005.
24. OECD , "Technology Incubators: nurturing small firms", Paris, 1997.
25. Nardo, Saisana, Saltelli , Tarantola, Tools for Composite Indicators Building 2005.
26. Saisana, M. and Tarantola, S. (2002) State-of-the-art report on current methodologies and practices for composite indicator development, EUR 20408 EN, European Commission-JRC: Italy.
27. Inter-Service consultation meeting of the European Commission held in Brussels on March 14th 2002.
28. Handbook on constructing composite indicator: methodology and user guide, OECD Statistics Working Paper, 2005
29. Forman E.H. "The analytic hierarchy process as a decision support system", Proceedings of the IEEE Computer society. 1983.