# Analysis of Strategic Management in Small and Medium Business Organizations in Graphic Industry

#### ABSTRACT

Graphic industry as a field of work and a field of study offers ability for economic growth of every country or region. The increase in competition and the development of the market method of prediction, increase the need for business organizations to continuously observe their own position. Faced with a variable, turbulent and complex environment, the business organizations adopt strategic management, and modern managers, especially those in top management, have to possess knowledge and skills of the concepts and application of strategic management.

In this paper the case method, as a method used in strategic management, will be applied as a general approach of strategic analysis in creating strategy map for businesses in graphic industry.

#### **KEY WORDS**

graphic industry, case analysis, strategy map

### Lili Boshevska, Ilija Jolevski

*OU "Sv. Kiril i Metodij",Technical Faculty Bitola,Macedonia* 

Corresponding author: LiliBoshevska e-mail: lilibitola@gmail.com

First recieved: 31.10.2012. Accepted: 3.1.2013

## Introduction

The companies in graphic industry around the world are occupied with adapting to transforming markets, transforming industries, and transforming business rules. These changes and transformations are caused by new view of customer satisfaction, and by new business paradigms. Through the growth of e-commerce and globalization, a wide variety of threats and opportunities have emerged. Any time people travel, go in a restaurant or theatre, buy in a market, go to the library, and engage in similar activities, they are using products of the graphic industry. The management of business organizations in graphic industry is very challenging, as managers need to be flexible enough to anticipate and meet a wide variety of needs. They must also handle tasks such as training employees, handling staff, setting standards, and applying different forms of collaboration and coordination between companies and within companies. The challenge is bigger because of the innovations in printing by exploiting business potentials of new or enhanced service, product, technology, information, communication or solution. That means that companies trying to find many different ways to intensify cooperation with customers and suppliers.

"The graphic industry is labor-intensive, which consequently reflects the high contribution of labor costs to the overall total compared to the average for industry as a whole". Also the graphic industry is capital-intensive. "At six or seven percent, investment within the printing industry is clearly higher than the average for industry overall. This primarily involves investment in modernization aimed at a competitive edge over direct rivals and investment to exploit new production methods, as well as adaptation to the growing number of suppliers providing alternative products, such as electronic media". (Kipphan, 2001, p. 1048-1049)

Many innovations in graphic industry are today a natural part of printing. To introduce these innovations however, complex transformations were necessary.

The transformation is not possible without strategy analysis making and determining the ways of development and potentials for economic development. The challenges of transformation of the companies in graphic industry are discussed and the transformation model of electronic business (Winter, 2001) is applied in transformation from a businesses for meeting basic needs into businesses for customer satisfaction.

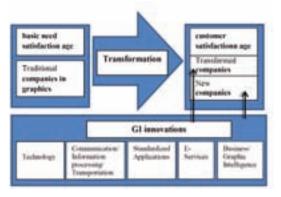
## Transformation as a challenge for developing a strategy

The transformation of the companies in graphic industry is a big challenge for the managers. "Digitization of equipment and workflow has brought new options for producing print products, the core business of the printing industry. For managers running printing companies this means in many cases a complete overhaul of equipment and a considerable challenge to employees in mastering new techniques. New production and communication technologies reveal not only new print media manufacturing processes, but also new communication media (electronic media), some of which are in direct competition with print media. This leads to the conclusion that training and further education has an essential role to play in this industry. The small to medium-scale structure of the printing industry demands above all that middle and particularly higher management levels possess relatively broad know-how, since the widespread use of specialists is considerably limited for financial reasons." (Kipphan, 2001, p. 1049)

Every business organization in graphic industry interested to be developed in the field of graphic engineering and design is in front of the question whether the transformation and transition to graphic business is a limited phenomenon or whether a sustainable economic development can be started.

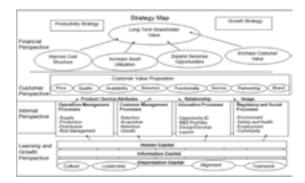
"Transformation means to re-create existing companies or to create new companies" (Winter 2001, p. 3). "Most transformations are triggered by new or improved" graphic components, new standards, new or improved standardized technologies, new services, or new forms of sourcing and utilization, etc.

The transformation model of informatics industry suggested by Österle and Winter (Winter 2001, p. 4) can be applied in a transformation model of graphic industry. According to the model, the role of innovations in graphic industry as transformation enablers is illustrated by Figure 1.



» Figure 1: Transformation Model of graphic industry according the Transformation Model (Österle&Winter, 2000) in (Winter 2001:p.4)

"From a business perspective, it is mandatory that business potentials of innovations" in graphic industry are "systematically assessed, that appropriate business strategies are (re-)formulated, that appropriate business processes and organizational structures are (re-) designed, and that appropriate information systems are implemented. Organizational structures may have to be decomposed and re-assembled, mergers and acquisitions may occur, business units may be sold, start-ups may have to be split off, or alliances or other forms of formal cooperation between companies may have to be created. In addition, transformation means that contracts have to be negotiated, appropriate qualifications have to be provided for employees, attitudes have to be changed, and political decision processes have to be modified." (Winter 2001, p.1049)



» Figure 2: Strategy map (Kaplan and Norton, 2003)

The new scope of graphic industry and the changed needs of the clients/customers, needs the analyses of existing strategy in graphic businesses, and develop a new one taking into account all economic perspectives, transformations and innovations in graphic engineering and design. The managers, who run the graphical business organizations, in the role of strategy developers, can merge two approaches: the Strategy map by Kaplan and Norton and The Case Method, to obtain the broad range of information and data for making analyses and creating the strategy (Boshevska, 2011).

The case method, as a method used in strategic management, can be applied as a general approach of strategic analysis in creating strategy map for businesses in graphic industry. Case analysis proceeds through the following seven stages or steps (Barnett and Wilsted 1989, 1) that can be passed from the aspect of management in graphic industry:

- Stage 1: Sizing up the situation
- Stage 2: Evaluating the present strategy
- Stage 3: Identifying issues and options
- Stage 4: Evaluating options
- Stage 5: Making recommendations
- Stage 6: Implementing strategy
- Stage 7: Monitoring results

Every stage can be reviewed from the four perspectives suggested by Kaplan& Norton: Financial perspective, Customer Perspective, Internal Perspective and Learning and growth Perspective, paying attention to every single element of the Strategy Map.

## First stage- Sizing up the situation (Assessing the situation)

In this stage the creators of strategy should answer the following questions:What the existing enterprises in graphic industry are doing in present? In what circumstances? With what results?

- 1. Analyze the economics of the sit ation: (Barnett and Wilsted 1989, 1),
  - Attributes of products and of the demand for them
  - Attributes of the technology, including the productive and distributive processes
  - The input mix, the cost mix, the unit (average) cost curve
  - The competitive situation both in the market for the inputs and in the market for the finished products
  - The price-cost-volume-profit relationships
- 2. Analyze opportunities and constrains, and strengths and weakness relative to them
- Identify the existing strategy , which refers to established policy concerning
  - Mission, objectives, and goals
  - Strategy being employed: to improve opportunities, to overcome constraints, to meet competition, to gain access to markets
  - Basic decisions concerning: products and markets, technology, make-or-buy, resource procurement, location, scale, standards. All this facts should be carefully collected, completed, selected and objectively analyzed.

The strategy makers can identify the existing strategy of the organization by studying its:

- » Pronouncements as to it purpose by looking for statements about what a company want to be or what it want to do. For instance: "We want to be Microsoft in graphic industry"...
- » Resource allocation-"Strategic pronouncements might be too general to be of help, or they might be contradictory or misleading" (Barnett and Wilsted 1989, 2), that is the reason why it is necessary to see where the money are spent and how the resources are located.
- » Products, services and markets in order to understand "What we are selling and to whom?". The strategy makers should analyze the existing products and services and answer questions like: Does an organization just print or do something more for people?
- » Method of competition in order to find out which elements in the strategy can be competitive: price, quality, technology, service, marketing skills, availability, functionality and/or brand. That means the organization can competes on the basis on elements of Customers Perspective but also on Internal Perspective including all internal processes.

#### **Evaluating the Present Strategy**

In this stage, Barnett and Wilsted suggested the following criteria for evaluation of the strategy plan: (Barnett and Wilsted 1989, 3),

- 1. Are the separate elements that make up the strategy consistent with each other and mutually supportive?
- 2. Is the strategy appropriate considering the surrounding circumstances (externalities) and the internal situation (resources, purpose)?
- 3. Are these policies and strategies likely to enable the enterprises to meet not only short-term goals but long-term objectives as well?
- 4. Have considerations of ethical and social responsibility been properly taken into account?
- 5. How satisfactory are the results?
- 6. Is the strategy practical and workable?
- 7. Does the strategy adequately consider risk?

#### **Identifying Issues and Options**

The strategy makers should identify what policy or strategy issues are most important, and what are the alternatives to these issues? It is very important to distinguish between primary and secondary issues and to concentrate on one, or on just a few primary issues. The analysis should be more effective by narrowing the field and sharpening the focus. Carefully considering a small number of important issues is far preferable to an extensive and, therefore, more superficial coverage. Cases often contain an "action" question which is only symptomatic of the real problem. (Barnett and Wilsted 1989, p. 4)

#### **Evaluating options**

In this stage, the strategy developers develop the arguments for and against each option, including the option of making no change from the present course of action. They need to consider costs and implications for organization and personnel. In this stage it is necessary to pay attention to elements of Financial Perspective, Internal Perspective and Learning and Growth Perspective from the Strategy Map. Barnett and Wilsted suggested consideration of the following criteria for each option: (Barnett and Wilsted 1989, p. 4)

- 1. Appropriateness: Will the option allow us to achieve our objectives?
- 2. Feasibility: Do we have the resources tangible and intangible to achieve our objectives?
- 3. Reality: Do we want to go with this option?
- Workability: Can we gain corporate wide organizational commitment?

#### **Making Recommendations**

After evaluating options, the strategy makers should consider what would they recommend for change in the present strategy? "And how these recommendations should be accomplished? Useful policy/strategy recommendations are specific, making explicit the rate of change and any scheduling or phasing being recommended; the additional resources, if any, to be procured; and any organizational and personnel changes involved." (Barnett and Wilsted 1989, p. 4)

#### **Implementing Strategy**

"A proposed strategy is useless unless organization commits to its adoption." Barnett and Wilsted recommend the following considerations: Who will be in charge of its implementation? What time frame is involved in its implementation? Does organization need to restructure, or is the present structure appropriate? Why? How will people be affected by its implementation? Will a new motivation or compensation system be necessary? How can be reviewed if the plan is not working?

#### **Monitoring Results**

The monitoring and appraisal of results is necessary for the strategy developers in determining if the strategy process and all elements of the Kaplan and Norton's Strategy Map are relevant and if the proposed recommendations can work. "Any variances must be quickly identified and corrected, so that operating remedies may be identified, evaluated, and implemented". (Barnett and Wilsted 1989, p. 4)

These seven stages for making analysis will help strategy makers to develop more quickly a logical approach to strategic problems. Since each organization is unique, some aspects of some or even all of these steps may not be appropriate according to the nature of the issues and alternatives. Taking in consideration two concepts mentioned before andthe differences of the particular organizations, it was created the form that can be used for analyzing of the strategic management in small and medium organizations in graphic industry. This form can be used in any organization in order to simplify the process of strategic analysis, and to facilitate the application of strategic management.

#### Table 1: Form for the analysis of strategic management in organization

Current situation	Desired condition (application of Benchmarking)	Gap
1. Assessing the situation		
In this stage the creators of strategy should answer the following existing enterprises in graphic industry are doing in present? In w		
With what results?	nat circuitistances:	
1. Analysis of the economic situation (Barnett and Wilsted 1989, 1	)	
1.1 Attributes of products and of the demand for them		
1.2 Attributes of the technology,		
including the productive and distributive processes		
1.3 The input mix, the cost mix,		
the unit (average) cost curve 1.4 The competitive situation		
both in the market for the inputs and in the market		
for the finished products		
1.5 The price-cost-volume-profit relationships		
What are the circumstances in which the organization exists		
2 "TOWS" analysis. Analysis of threats and o	pportunities, and	
weakness and strengths relative to them Threats- constrains		-
-Limitations		
Opportunities		
Strengths		
Weakness		
What results the organization achieves 3 Identify the existing strategy , which refers	to established	
policy concerning:		
3.1 Mission:		
Objectives:		
Goals:		
3.2 Strategy being employed: - to improve opportunities		
- to overcome constraints,		
- to meet competition, - to gain access to markets		
to gain access to markets     3.3 Basic decisions concerning:		
- products and markets,		
- technology,		
- make-or-buy, - resource procurement,		
- location,		
- scale, - standards		
Statements about what a company want to be		
or want to do		
<ul> <li>-Statement of Strategy</li> </ul>		
<ul> <li>-Vision Statement</li> </ul>		
Resource allocation - where the money are spent		
and how the resources are located?		
Products, services and markets - what the		
organization is selling and to whom? Method of competition - which elements in		
the strategy can be competitive: price, quality,		
technology, service, marketing skills, availability, functionality and/or brand.		
2. Evaluating the Present Strategy	I	
In this stage, Barnett and Wilsted suggested the following criteria	a for evaluation of the strategy plan: (Barnett a	nd Wilsted
1989, 3), 1. Are the separate elements that make up the		
I. Are the separate elements that make up the strategy consistent with each other and mutually		
supportive?		
2.1s the strategy appropriate considering the surrounding circumstances (externalities) and the		
internal situation (resources, purpose)?		
3.Are these policies and strategies likely to enable		
the enterprises to meet not only short-term goals but long-term objectives as well?		
4,Have considerations of ethical and social		
responsibility been properly taken into account?		
5.How satisfactory are the results?		
6.Is the strategy practical and workable?		
7.Does the strategy adequately consider risk		
3. Identifying Issues and Options		
It is very important to distinguish between and to concentrate or few primary issues. The analysis should be more effective by nar		
sharpening the focus.(Barnett and Wilsted 1989, 4)		
What policy or strategy issues are most important		
- primary issues: - secondary issues:		
What are the alternatives to these issues? What are		
the options available to the organization? Option 1:		
Option 2:		

Current situation						Desired condition (application of Benchmarking)			Gap		
4.Evaluating options										_	
To develop the argum		and a	gainst e	ach optio	n, and to	consider co:	sts and				
implications for organ											
attention to elements											
and Growth Perspect											
consideration of the f											
1. Appropriateness: V	Vill the o	ption	allow u	s to achie	ve our ob	jectives?					
2. Feasibility: Do we l objectives?							eve our				
3. Reality: Do we war	-										
4. Workability: Can w	ve gain ci	orpora	te – wi	de organi	zational c	ommitment					
	for				agair	ist				T	
Option 1:											
Option 2:	-				-			1			
	-				-			+			
Option3:	L										
5. Making Recomme											
Specific recommenda											
How these recommendation					ed?						
How to provide the a											
How to perform orga	anization	al and	person	nel chang	jes?						
Recommendation1											
Recommendation 2											
Recommendation 2 Recommendation 3	_									_	
Recommendation 3 6. Implementing Stra "A proposed strategy Barnett and Wilsted I	is usele						ption."				
Recommendation 3 6. Implementing Stra "A proposed strategy Barnett and Wilsted I Who will be in charge	is usele						ption."				
Recommendation 3 6. Implementing Stra "A proposed strategy Barnett and Wilsted of Who will be in charge implementation?	ris usele: recomm e of its	end th					ption."				
Recommendation 3 6. Implementing Strat "A proposed strategy Barnett and Wilsted a Who will be in charge implementation? What time frame is in	ris usele: recomm e of its	end th					ption."				
Recommendation 3 6. Implementing Strat "A proposed strategy Barnett and Wilsted i Who will be in charge implementation? What time frame is in implementation?	recomme recomme e of its	end th					ption."				
Recommendation 3 6. Implementing Strat- "A proposed strategy Barnett and Wilsted I Who will be in charge implementation? Is the present structu	recomme recomme e of its	end th					ption."				
Recommendation 3 6. Implementing Strategy Barnett and Wilsted Who will be in charge implementation? What time frame is in implementation? is the present structu appropriate?	recomme recomme e of its nvolved i ure	n its					ption."				
Recommendation 3 6. Implementing Strategy Barnett and Wilsted Who will be in charge implementation? What time frame is in implementation? Is the present structu appropriate? Does the organization	recomme recomme e of its nvolved i ure	n its					ption."				
Recommendation 3 6. Implementing Strategy Barnett and Wilsted 3 Who will be in charge implementation? What time frame is in implementation? Is the present structu appropriate? Does the organization restructure. Why?	r is usele: recomme e of its nvolved i ure n need to	n its					ption."				
Recommendation 3 6. Implementing Strategy Barnett and Wilsted Who will be in charge implementation? What time frame is in implementation? What time frame is in implementation? Does the organization restructure. Why? How will people be at	r is usele: recomme e of its nvolved i ure n need to	n its					ption."				
Recommendation 3 6. Implementing Stra "A proposed strategy Barnett and Wilsted Who will be in charge implementation? Is the present structu appropriate? Does the organization restructure. Why? How will people.	r is usele: recomme e of its nvolved i ure n need to ffected b	n its					ption."				
Recommendation 3 6. Implementing Stra "A proposed strategy implementation? What time frame is in implementation? Unst the organization is the present structure appropriate? Does the organization restructure. Why? How will people be at its implementation? Will a new motivatio	r is useler recomme e of its nvolved i ure n need to ffected b	n its					ption."				
Recommendation 3 6. Implementing Stra "A proposed strategy Implementation? Barnett and Wilsted Barnett and Wilsted What time frame is in implementation? Is the present structure. Why? Does the organization restructure. Why? Does the organization restructure. Why? Will a new motivation Structure in the structure. The structure is the structure is the structure. Will a new motivation system	r is useler recomme e of its nvolved i ure n need to ffected b	n its					ption."				
Recommendation 3 6. Implementing Stra "A proposed strategy implementation? What time frame is in implementation? Unst the organization is the present structure appropriate? Does the organization restructure. Why? How will people be at its implementation? Will a new motivatio	r is useler recomme e of its nvolved i ure n need to ffected b	n its					ption."				
Recommendation 3 6. Implementing Stra "A proposed strategy Implementation? Barnett and Wilsted Barnett and Wilsted What time frame is in implementation? Is the present structure. Why? Does the organization restructure. Why? Does the organization restructure. Why? Will a new motivation Structure in the structure. The structure is the structure is the structure. Will a new motivation system	r is useles recomme e of its nvolved i ure n need to ffected b in or n be	n its					ption."				
Recommendation 3 6. Implementing Stror "A proposed strategy Barnett and Wilsted Who will be in charge miplementation? What time frame is in implementation? What time frame is in the present structure appropriate? Does the organization restructure. Why? How will people be al timplementation? Will a new motivatio compensation system necessary?	r is useles recomme e of its nvolved i ure n need to ffected b in or n be	n its					ption."				
Recommendation 3 6. Implementing Stra "A proposed strategy implementation? What time frame is in implementation? Ubat time frame is in implementation? I bis the present structure appropriate? How will people be at its implementation? Will a new motivatio compensation system necessary?	r is usele: recomme e of its nvolved i ure n need to ffected b in or n be d if the pl	n its o yy		ving consi			ption."				
Recommendation 3 6. Implementing Stra "A proposed strategy Barnett and Witsted Barnett and Witsted Barnet and Witsted What time frame is in implementation? Is the present structu appropriate? Does the organization restructure. Why? Does the organization restructure. Why? Will a new motivation tis implementation? Will a new motivation compensation system necessary? How can be reviewed is not working?	r is usele: recomme e of its nvolved i ure n need to ffected b in or n be d if the pl Monit	In its or	Results	ving consi	iderations	х 					
Recommendation 3 6. Implementing Stra "A proposed strategy Barnett and Wilsted Barnett and Wilsted Barnett and Wilsted Barnet and Wilsted With time frame is in implementation? Will a new motivatio compensation system necessary? How can be reviewed is not working? 7.	r is usele: recomme e of its avolved i ure n need to ffected b n or n be d if the pl Monit appraisal	In its or	e follov	ecessary	in determ	: ining if the s	trategy				
Recommendation 3 6. Implementing Stra "A proposed strategy Barnett and Winess Barnett and Winess What time frame is in implementation? What time frame is in pappropriate? Does the organization restructure. Why? Does the organization restructure. Why? Will a new motivation compensation system necessary? How can be reviewed is not working? 7. The monitoring and a	r is usele: recommune of its involved i involved i i i involved i i i i i i i i i i i i i i i i i i i	In its	e follov Results Results Its is n Ian and	ecessary Norton's	in determ	: ining if the s Map are relet	trategy				
Recommendation 3 6. Implementing Stro 74 proposed strategy Barnett and Wilsted Who will be in charge Implementation? What time frame is in implementation? What time frame is in the present structure appropriate? Does the organization compensation system recessary? Who wan be reviewed is not working? 7 The monitoring and all eleme	r is usele: recommune a of its involved i in or in or in or d if the pl d if the pl Monit	In its In	e follov Results Results Its is n Ian and ons can	ecessary Norton's	in determ Strategy I ny variance	ining if the s Wap are relevent	trategy vant uuckly				
Recommendation 3 6. Implementing Stra "A proposed strategy implementation? What time frame is in implementation? Ubat time frame is in implementation? How will people be al its implementation? How will people be al its implementation? Will a new motivatio compensation system necessary? The monitoring and al process and all eleme and if the proposed r	r is usele: recommune e of its not of its not of its not	Ian of reserved and the second	Results Results is n lan and ons can erating	ecessary Norton's remedies	in determ Strategy I ny variance	ining if the s Wap are relevent	trategy vant uuckly				
Recommendation 3 6. Implementing Stra "A proposed strategy Barnett and Wilsted Who will be in charge implementation? What time frame is in implementation? Uses the organization to the organization to the organization structure. Why? Will a new motivatio compensation system Will a new motivatio compensation system Thomonitoring and a process and all elem and if the proposed f identified and correct implemented". [Barn	r is usele: recommune e of its not of its not of its not	Ian of reserved and the second	Results Results is n lan and ons can erating 1989,4	ecessary Norton's remedies	in determ	ining if the s Wap are relevent	trategy vant uuckly				
Recommendation 3 6. Implementing Stror "A proposed strategy Barnett and Wilsted Who will be in charge implementation? What time frame is in implementation? What time frame is in the present structure, appropriate? Does the organization compensation system the implementation? Will a new motivatio compensation system the monitoring and an process and all eleme and if the proposed f	r is usele: recommune e of its not of its not of its not	Ian of reserved and the second	Results Results is n lan and ons can erating 1989,4 Requi	ecessary Norton's remedies	in determ Strategy ny variane may be in	ining if the s Wap are relevent	trategy vant uuckly				

## Conclusion

The strategic analysis in any organization in graphic industry can be delivered with different approaches, methods and techniques. A consistency should exist in developing a general strategy and strategy for separate businesses development. The economics of graphic industry influence the graphic companies and opposite the company's success has impact on the whole industry. That is very important for strategy developers because they should look for information about the industry in general and to determine the influence of the general economy to the graphic industry and vice versa. Also the strategy developers should find out the general trend of the graphic industry sales and the characteristics of the graphic industry such as: number of graphic companies, percentage share of industry sales, barriers to entry, capital versus labor intensity, value added, level of competition, method(s) of competition, rate of technological change, research and development expenditures, international factors and regulatory factors.

The general strategy of graphic industry has strategic implications on the development of every particular company. The success of a specific company versus the success of the industry as a whole can show the capabilities of the companies and their strength relative to the strength of the graphic industry.

By analyzing a strategy, the business organizations in graphic industry can identify critical aspects about the way of defining the company's strategy, the way of spending its resources, the way of providing products and services, which products or services can be produced and sell to which clients or customers, the way of competing with other companies.

Using the case method, the strategy analysis makers can answer the relevant questions and move from the identification of strategy to the more demanding evaluation of strategy, identifying issues and options, evaluating options, making recommendations, implementing strategy and monitoring results.

As a result of merging the Strategy map by Kaplan and Norton and The Case Method, the strategy makers will obtain the broad range of information and data for making analyses and creating the strategy.

### References

- Barnett, J. and Wilsted, W. (1989) Cases for strategic management, Boston: PWS-KENT
- Boshevska, L. (2011) Hospitality Management and Strategic Analysis in Creating Businesses in Hospitality Industry. In: Proceedings of Second Biennial International Scientific Congress "The Influence of Tourism on Economic Development", Skopje: University of Tourism and Management
- Boshevska, L., Jolevski, I. (2012) Strategic Management in Business Organizations in Republic of Macedonia, in Proceedings of VIII May conference of strategic management, Bor: Technical Faculty in Bor, pp.391-400
- Kaplan, R.S., Norton, D. P. (2003) Strategic maps, [Online] Available from:http://www.valuebasedmanagement.net/images/strategy\_map\_kaplan\_ norton.pdf .[Accessed 09th December 2009]
- Kipphan, H. (2001) Handbook of Print Media: Technologies and Production Methods, Berlin, Heidelberg, New York: Springer
- Winter, R. (2001) Working for e-Business- The Business Engineering Approach, International Journalof Business Studies, 9 (1), pp. 101-117[Online] Available from:citeseerx.ist.psu.edu/viewdoc/ download?doi=10.1.1.194.4623&rep=rep1&type=pdf [Accessed 20th November 2010]