



**HAL**  
open science

## The influence of manufacturing flexibility on the interplay between exploration and exploitation: The effects of organizational learning and the environment

Javier Tamayo-Torres, Antonia Ruiz Moreno, Francisco Javier Llorens Montes

### ► To cite this version:

Javier Tamayo-Torres, Antonia Ruiz Moreno, Francisco Javier Llorens Montes. The influence of manufacturing flexibility on the interplay between exploration and exploitation: The effects of organizational learning and the environment. *International Journal of Production Research*, 2011, pp.1. 10.1080/00207543.2010.518989 . hal-00661559

**HAL Id: hal-00661559**

**<https://hal.science/hal-00661559>**

Submitted on 20 Jan 2012

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



**The influence of manufacturing flexibility on the interplay between exploration and exploitation: The effects of organizational learning and the environment**

Journal:	<i>International Journal of Production Research</i>
Manuscript ID:	TPRS-2009-IJPR-1143.R2
Manuscript Type:	Original Manuscript
Date Submitted by the Author:	30-Jul-2010
Complete List of Authors:	Tamayo-Torres, Javier; University of Granada, Business Management MORENO, ANTONIA; University of Granada, Business Management MONTES, FRANCISCO JAVIER; University of Granada, Business Management
Keywords:	FLEXIBLE MANUFACTURING, KNOWLEDGE MANAGEMENT, ENVIRONMENT, LEARNING
Keywords (user):	

SCHOLARONE™  
Manuscripts

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**THE INFLUENCE OF MANUFACTURING FLEXIBILITY ON THE INTERPLAY  
BETWEEN EXPLORATION AND EXPLOITATION: THE EFFECTS OF  
ORGANIZATIONAL LEARNING AND THE ENVIRONMENT**

Tamayo Torres, Javier<sup>1</sup>

Ruiz Moreno, Antonia<sup>2</sup>

Lloréns Montes, Fco. Javier<sup>3</sup>

<sup>1</sup>*Associate Professor. Management Department  
Universidad de Granada. Phone: (34)-958-24-95-96; Fax: (34)-958-24-62-22  
e-mail: [jatamayo@ugr.es](mailto:jatamayo@ugr.es)*

<sup>2</sup>*Associate Profesor. Management Department  
Universidad de Granada. Phone: (34)-958-24-09-16; Fax: (34)-958-24-62-22  
e-mail: [aruizmor@ugr.es](mailto:aruizmor@ugr.es)*

<sup>3</sup>*Full Profesor. Management Department  
Universidad de Granada. Phone: (34)-958-242354; Fax: (34)-958-24-62-22  
e-mail: [fllorens@ugr.es](mailto:fllorens@ugr.es)*

*Full Postal Address:  
Facultad de Ciencias Económicas y Empresariales  
Campus de Cartuja s/n  
18071. Granada  
Spain*

1  
2  
3  
4  
5  
6  
7  
8  
9

## The influence of manufacturing flexibility on the interplay between exploration and exploitation: The effects of organizational learning and the environment

10  
11

### Abstract

12 This paper analyzes whether the firm can combine exploration and  
13 exploitation and seeks to determine whether implementing manufacturing  
14 flexibility will facilitate the development of either of these two terms or both  
15 simultaneously. This relationship was measured in 231 Spanish production  
16 firms. The results obtained show that: (1) firms develop exploration of new  
17 knowledge at the same time as they exploit their abilities; (2)  
18 manufacturing flexibility encourages the development of both exploration  
19 and exploitation; (3) this relationship is even more significant if we take  
20 into account dynamism of the environment and organizational learning.  
21  
22  
23  
24  
25  
26  
27  
28

29 Key words: manufacturing flexibility, exploration, exploitation.  
30  
31  
32

### 1. Introduction

33  
34  
35

36 Many new product development (NPD) companies today operate in  
37 uncertain and dynamic competitive environments (Kettunen, 2009). The  
38 changing nature of the environment, internationalization of markets,  
39 growing competitiveness and development of new technologies require  
40 managers to implement dynamic production systems (Das and  
41 Narasimham, 1999), in order to satisfy the customer's needs effectively and  
42 to achieve competitive advantage over competitors. As a result,  
43 manufacturing flexibility becomes a competitive key for all firms and their  
44 production systems (Wang *et al.*, 2006). Greater manufacturing flexibility,  
45 along with a competitive strategy appropriate to the sector, will enable  
46 adaptation to changes in the environment, or even the ability to anticipate  
47 changes that may arise, giving the firm a competitive advantage over its  
48 competitors (Beach *et al.*, 2000).  
49  
50  
51  
52  
53  
54  
55  
56  
57

58 In order to achieve competitive advantage, organization managers seek  
59 to develop the new capacities and competences needed to adapt to  
60 variations in their environment, and thus obtain better margins than other

1  
2  
3 firms in the sector. There are two ways for firms to gain such knowledge:  
4 capturing information from the environment surrounding them and  
5 encouraging development of their own abilities, whether through interaction  
6 among their employees or through interaction with the hypercompetitive  
7 environment (Jansen *et al.*, 2006). We thus seek to analyze how the  
8 abilities of manufacturing flexibility, exploration, exploitation and  
9 organizational learning taken together enable the firm to respond to the  
10 environment and to obtain competitive advantages.  
11  
12  
13  
14  
15  
16

17  
18 Recent changes in the environment present us the importance of this  
19 study. Such changes have made manufacturing flexibility one of the main  
20 aspects for firms to consider when making decisions about how to compete  
21 with other organizations. Although some literature on manufacturing  
22 flexibility does exist, there remain gaps to be filled. Our study is based on a  
23 theoretical review of the literature as well as previous literature reviews  
24 such as those conducted by Sethi and Sethi (1990) and Beach *et al.* (2000).  
25 We attempt to resolve contradictions in the literature and to develop the  
26 theoretical arguments supporting the relationship between manufacturing  
27 flexibility and the terms exploration and exploitation. Based on these  
28 theoretical foundations, we attempt to make an empirical contribution by  
29 proposing a model that considers how the implementation of manufacturing  
30 flexibility influences exploration of new knowledge or exploitation of the  
31 firm's abilities.  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41

42 The scientific interest of this research exists, firstly, in the need to  
43 accept that production firm flexibility is a new current of knowledge in  
44 strategic management, one that can give the organization competitive  
45 advantages and facilitate the organization's process of change. Secondly, in  
46 the importance of understand the different behaviour that organizations  
47 manifest when developing their abilities.  
48  
49  
50  
51

52 This study has two goals. First, we seek to demonstrate whether  
53 exploration and exploitation can be developed simultaneously in the same  
54 firm (Debenham and Wilkinson, 2006; Li *et al.*, 2008) or whether they are  
55 incompatible due to the scarcity of resources, as March (1991) proposes.  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65  
66  
67  
68  
69  
70  
71  
72  
73  
74  
75  
76  
77  
78  
79  
80  
81  
82  
83  
84  
85  
86  
87  
88  
89  
90  
91  
92  
93  
94  
95  
96  
97  
98  
99  
100

1  
2  
3 learning moderate the relationship between manufacturing flexibility and  
4 strategic behaviour.  
5

6 The rest of this paper is structured as follows: Sections 2 and 3 explore  
7 the background of and related work on exploration, exploitation and  
8 manufacturing flexibility, in order to help us to establish definitions of both  
9 concepts used in this research. Next, in Section 4, we suggest a series of  
10 hypotheses in a global model. Section 5 justifies the methodology and  
11 sample, including the design of the research instrument, the data collection  
12 procedures and the process of construct validation. Section 6 presents the  
13 results obtained. Finally, in Section 7, we analyse the main contribution of  
14 our research.  
15  
16  
17  
18  
19  
20  
21

## 22 23 24 **2. The balance between exploration and exploitation** 25

26  
27 The terms exploration and exploitation have evolved greatly since the  
28 publication of the study by March (1991). They have come to dominate the  
29 literature related to technological innovation in the organization, to the  
30 design of the organization, and its adaptation to the environment (both  
31 internal and external), to organizational learning and to the search for  
32 competitive advantage (Siggelkow and Levinthal, 2003; Taylor and Greve  
33 2006). Competing in a dynamic market, firms today must perform different  
34 tasks, explore new possibilities for adapting to future changes in the  
35 environment, and exploit the abilities they have already developed in order  
36 to meet the current demands on the firm (Lavie and Rosenkopf, 2006).  
37  
38  
39  
40  
41  
42  
43

44 March (1991) defined the term exploration as "search, variation, risk  
45 taking, experimentation, play, flexibility, discovery, innovation" and  
46 exploitation as "refinement, choice, production, efficiency, selection,  
47 implementation and execution", making an initial distinction between the  
48 two terms.  
49  
50  
51  
52

53 Both concepts have completely different objectives. While the main goal  
54 of exploration is achieving flexibility and developing new knowledge and  
55 new ways of solving the problems that arise in the firm, exploitation takes  
56 shorter term and more specific perspective (March, 1996).  
57  
58  
59

60 Exploration is linked to and developed through different activities that  
increase organizational processes, activities such as complex searches, deep

1  
2  
3 research, greater risks for the firm and disruptions of bureaucratic tasks  
4 with many rules (Levinthal and March, 1993). Exploratory behaviours are  
5 those that seek to win the technological race in new niches and achieve  
6 competitive advantages in order to develop new products and technologies  
7 (Beckman, 2006).  
8  
9

10  
11 In contrast, exploitation seeks to increase efficiency, reduce periods  
12 without sales, and increase the reliability or precision of all activities. It is  
13 performed through activities that seek to reduce changes in the  
14 organization's processes, or to establish standardized processes (March,  
15 1996).  
16  
17

18  
19 As these concepts evolve over the years, we see different points of view  
20 that relate these concepts to many topics of interest in the literature on the  
21 firm and its environment (Gupta *et al.*, 2006). Among these, we must  
22 mention the relation to *organizational learning*. If we relate the terms to the  
23 firm's search for knowledge, we find exploitation defined as the firm's  
24 learning via search for information, experimental refinement, choice, and  
25 reuse of existing routines; whereas exploration is defined as acquiring  
26 knowledge through changes in established firm processes, planned  
27 experiments, or different kinds of tests (Baum *et al.*, 2000).  
28  
29

30  
31 From the study by March (1991), exploration and exploitation refer to  
32 two ways of learning of the company. But theory has evolved greatly over  
33 the years, and we can find different points of view that enable us to  
34 consider these two terms not only as two ways of learning for the firm (Li *et*  
35 *al.*, 2008). In fact, Calantone *et al.* (2007) believe that the two terms  
36 should be treated as basic concepts in defining entrepreneurial strategy.  
37  
38

39  
40 In developing these terms, the literature makes continual reference to  
41 whether exploration and exploitation are two contrary and mutually  
42 exclusive terms or whether they are extremes on a *continuum* on which  
43 each firm should choose where it wishes to be situated, while developing  
44 both terms together.  
45  
46

47  
48 March (1991), for example, argues that, despite exploration and  
49 exploitation are fundamental for the firm in the long term, they are basically  
50 incompatible to perform efficiently, due to the scarcity of resources. They  
51 will only cause an increase in costs and poor use of production time. This  
52 means that a larger quantity of resources for research (exploration) means  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 a smaller quantity of resources for the development of the capacities  
4 belonging to the organization's personnel (exploitation) and viceversa.  
5

6  
7 In contrast, other authors believe that firms should efficiently combine  
8 exploitation of ideas already developed with exploration of new needs with  
9 the intention of both satisfying customers' daily needs and anticipating  
10 changes in demand (Danneels, 2004; Boer and Laugen, 2008).  
11

12  
13 The literature thus presents the following question: "Is the interaction of  
14 the two terms possible?" (Hamel, 2006). This situation presents two  
15 possibilities: The first is the binary relation of the two concepts and the  
16 second is the possibility of dual organizations developing the concepts of  
17 exploration and exploitation in a perpendicular or synergic way,  
18 respectively. Many authors see the answer in ambidextrous organizations  
19 (Christensen, 1998; Benner and Tushman, 2002), which show the  
20 simultaneity of the two behaviours within one firm.  
21

22  
23 There are also authors who consider the possibility of a balance between  
24 exploration and exploitation (Burgelman, 2002) or cycles of time divided  
25 between long periods of exploitation of abilities and short periods of  
26 exploration of new knowledge (Boer and Laugen, 2008). Miller *et al.* (2006)  
27 in fact underscores the possibility that duality and specialization may exist  
28 in the same organization. That is, while the firm is developing duality in  
29 some specific departments, it is developing specialization successfully in one  
30 or the other.  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41

### 42 **3. Manufacturing flexibility**

43  
44  
45 The term manufacturing flexibility is a complex, multidimensional  
46 concept that is difficult to define and that has been evolving over the years  
47 (Sethi and Sethi, 1990). It combines several factors, such as corporate  
48 culture, organizational structure, technology of processes, organizational  
49 design and/or information on the system (Beach *et al.*, 2000).  
50

51  
52 Throughout the literature, we find different definitions of the concept.  
53 Cox (1989) defines manufacturing flexibility as "the speed and facility with  
54 which manufacturing plants can respond to changes in market conditions."  
55 Sethi and Sethi (1990) consider manufacturing flexibility to be a set of  
56 elements that are designed as a whole and carefully related in order to  
57  
58  
59  
60



1  
2  
3 facilitate the adaptation of processes and equipment to all production tasks.  
4  
5 A more comprehensive definition used generally by many authors is "the  
6  
7 ability to change or react with the least time, cost, damage or performance"  
8  
9 (Upton, 1994).

10 The term manufacturing flexibility is so important for authors that it has  
11  
12 received attention from different perspectives. Beach *et al.* (2000) indicate  
13  
14 that it can be used strategically in many different ways. They recommend  
15  
16 that it must be one of the dimensions of a system's competitive strategy,  
17  
18 along with price, quality and reliability.

19 If the company wants to solve customer's desire, the organization must  
20  
21 seek flexibility in the value chain (Zhang, 2001; Wang *et al.*, 2006).  
22  
23 Flexibility in the value chain influences such areas as the development of  
24  
25 products, manufacturing, and logistics, for example. It enables firms to  
26  
27 introduce new products rapidly and to reduce manufacturing times and  
28  
29 commercialization costs (Zhang, 2001).

30 There is one concept of manufacturing flexibility is generally accepted in  
31  
32 the literature, it is its multidimensionality within the function of  
33  
34 manufacturing. Researchers agree that it is a complex, multidimensional  
35  
36 concept difficult to delimit (De Toni and Tonchia, 1998; Baykasoğlu, 2009),  
37  
38 but they do not agree on the dimensions involved. The problem for  
39  
40 organization managers is determining which dimension of manufacturing  
41  
42 flexibility to develop in order to adapt to each kind of environment and its  
43  
44 uncertainty (Van Hop and Ruengsak, 2005). With the hope of facilitating  
45  
46 analysis of this problem, we have studied the most used dimensions, shown  
47  
48 in the Appendix.

49 This study of the different dimensions of manufacturing flexibility has led  
50  
51 us to choose six dimensions, which will enable us to analyze whether  
52  
53 manufacturing flexibility influences exploration and/or exploitation. These  
54  
55 dimensions are *routing flexibility, sequence, modification, material handling,*  
56  
57 *machine* and *mix flexibility*. We have chosen these dimensions because they  
58  
59 are the ones in the literature that articulate what can contribute the  
60  
greatest significance (Zhang *et al.*, 2003).

#### 4. Model and hypotheses

Our model (Figure 1) presents two kinds of relationships in the firm. On the one hand, we attempt to confirm whether exploration and exploitation may be made compatible in a single production plant or organization (Li *et al.*, 2008). To achieve this, we will treat both concepts as *strategic behaviours* of the firm, by which we mean that they are the ways of acting that the organization seeks to develop, the way of learning and the basis for being able to develop new concepts (Levinthal and March, 1993).

On the other hand, we believe it is interesting to analyze whether the development of flexibility in production firms benefits the development of any of these strategic behaviours and whether dynamism of the environment and organizational learning moderate the relation between manufacturing flexibility and strategic behaviours. These relationships emerge from studies like those by Jansen *et al.* (2006), in which we find the importance of dynamism of the environment as a moderating variable in the relationship between both strategic behaviours and the organization's performance, and in studies like that of Dixon *et al.* (2007), which finds a close relation between learning and exploration and exploitation for the organization's workers.

Although our study does not focus exclusively on the firm's strategic behaviours but rather on the relation of manufacturing flexibility to these, we will begin by verifying the relation proposed in prior studies like those by Qian *et al.* (2007).

We thus present the following theoretical model (Figure 1), which will enable us to analyze different hypotheses:

#### Figure 1: Theoretical model

We wish to highlight the importance of strategic behaviour for the organizations' managers, since exploitation seeks to act rapidly and directly (March, 1991) and considers short-term results crucial, whereas exploration has long-term goals and occurs in firms that do not seek immediate results but instead propose projects that will take several years. As we know,

1  
2  
3 taking into account both the short and the long term are crucial tasks in the  
4 organization's strategy.  
5

6  
7 The continuous evolution of markets has changed the thinking of experts  
8 in this subject matter. During the 1990s, both behaviours were considered  
9 to be incompatible, primarily due to the scarcity of resources (March, 1991).  
10 However, over time researchers have developed the idea that it might be  
11 possible to combine these two strategic behaviours in the same firm, even  
12 in the same production plant.  
13  
14

15  
16 Thus, most of the studies in this century refer to the facility or difficulty  
17 that firms have in implementing both concepts. These studies attempt to  
18 show whether one of these strategic behaviours depends on the other, or  
19 whether they should be treated as substitutable parts of organizational  
20 decisions (Gupta *et al.*, 2006; Debenham and Wilkinson, 2006; Li *et al.*,  
21 2008).  
22  
23

24  
25 Establishing a balance between exploration and exploitation is very  
26 complex for researchers because different results and even different models  
27 of implementation are obtained, depending on the place in the organization  
28 that they study. This possible point of balance has led some authors to  
29 present the idea of ambidextrous organizations, in which both concepts can  
30 be developed simultaneously (Christensen, 1998; Benner and Tushman,  
31 2002). Other authors believe, however, that it may be useful to have a  
32 balance between exploration and exploitation, but one based on cycles of  
33 time divided between long periods of exploitation of abilities and short  
34 periods of exploration of new knowledge (Burgelman, 2002).  
35  
36

37  
38 Taking all of this into account, we can propose the first of the  
39 hypotheses for our theoretical model:  
40  
41

42  
43 **H1.** *Exploration and exploitation are compatible strategic behaviours in*  
44 *organizations.*  
45  
46

47  
48  
49  
50  
51  
52  
53  
54 Exploration and exploitation are essentially strategic terms (March,  
55 1991); they are options that those managing an organization should think  
56 about and carry out after an analysis of entrepreneurial possibilities.  
57 Debenham and Wilkinson (2006) indicate that the firm's strategic  
58 behaviours have a strong relation to the goals or specific strategy of the  
59  
60

1  
2  
3 organization. They emphasize the need to use one of the two behaviours to  
4 obtain the performance desired. We have thus found the first relationship  
5 between the firm's strategic behaviours and manufacturing flexibility, as it  
6 should form part of the entire organization's strategy, the strategy it wishes  
7 to establish in the competitive market.  
8  
9

10  
11 Further, if we examine the definitions given by March (1991), we find  
12 exploration as "search, change, risk-taking, experimentation, play,  
13 flexibility, discovery and innovation." This definition stresses that one of the  
14 possibilities for strategic behaviour depends on the organization's flexibility.  
15 But exploration is not the only term for conceiving of the organization's  
16 flexibility. Baum *et al.* (2000) define exploitation as "learning in the firm  
17 through search, experimental refining, selection and reuse of existing  
18 routines in the firm," defining this reuse of routines as the firm's capacity to  
19 adapt its functioning to the needs of the moment, that is, to be flexible.  
20  
21

22  
23 The main problem involves how to measure manufacturing flexibility.  
24 Like many other authors who analyze the concept, Sethi and Sethi (1990)  
25 refer to the possibility of measuring it by establishing a classification of the  
26 different dimensions of flexibility that can be developed in the organization  
27 (Koste and Malhotra, 2004; Wadhwa *et al.*, 2009). This means that they  
28 cannot establish a fixed measurement model, since each firm has its own  
29 characteristics and the dynamically evolving environment is developing new  
30 forms of action and new ways of measuring these movements (Chang *et al.*,  
31 2006; Treville *et al.*, 2007). We can even find studies, like that by Anand  
32 and Ward (2004), in which the term is treated as a whole, using a set of  
33 items that measure the global character of the concept of manufacturing  
34 flexibility.  
35  
36

37  
38 Exploration involves "finding new alternatives that improve what  
39 currently exists" (March, 1991), whereas the methods for applying  
40 exploitation in the firm appear to be "acting in the right way; adopting  
41 standard products; assuming a formal structure; defining and measuring  
42 performance, eliminating redundancies, creating routes, specializing...",  
43 (Levinthal and March, 1993). We can thus affirm that strategic behaviours  
44 seek new ways of adapting to the environment (Li *et al.*, 2008) and  
45 different ways to improve production in the organization. As we can see,  
46 one way a firm can adapt and improve the production process is by  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 searching for knowledge, whether through entrepreneurial innovations or  
4 through reorientation of its own abilities. That is, establishing new  
5 production routes in the firm—whether through the re-establishing some of  
6 the parts of the firm or through implementing a new process that enables it  
7 to change its production routing—will improve the firm’s strategic behaviour  
8 (Koste and Malhotra, 2004).  
9

10  
11  
12  
13 When we focus on manufacturing flexibility, we find references to the  
14 number of different tasks that a machine can perform (Barad and Hoang,  
15 1996; Chen *et al.*, 1992), the cost that the firm incurs for changing to  
16 another machine due to periods of non-use (Gupta, 1993), and the cost of  
17 customizing machinery or explaining the different tasks to the workers  
18 (Petroni and Bevilacqua, 2002). If manufacturing flexibility seeks to reduce  
19 costs and waiting time, for example, strategic behaviours attempt to reduce  
20 these productions costs, whether in the short term through the exploitation  
21 of abilities, or in the long term through the exploration of new ideas and  
22 projects (Miller *et al.*, 2006).  
23  
24  
25  
26  
27  
28  
29

30  
31 Thus, following the suggestions of the most significant authors in the  
32 literature, we have chosen six dimensions of manufacturing flexibility and  
33 we will try to establish whether they can affect the firm’s strategic  
34 behaviour as a whole. These dimensions are modification flexibility, routing,  
35 sequence, material handling, machine and mix flexibility (Wahab, 2005; Ali  
36 and Wadhwa, 2009).  
37  
38  
39  
40

41 We thus propose the following global hypothesis:  
42  
43

44 **H2.** *Manufacturing Flexibility influences exploration and exploitation in*  
45 *the firm.*  
46  
47  
48

49  
50 Our model does not seek to determine only the relation between  
51 manufacturing flexibility and strategic behaviour. Rather, it shows whether  
52 the variables dynamism of environment and organizational learning  
53 moderate the relation between both of them.  
54  
55

56  
57 We observe that the external environment of the firm as a contextual  
58 factor of the firm has been and continues to be an object of interest in the  
59 literature (Mintzberg, 1980; Nahm *et al.*, 2003). Having the right close  
60 relation between flexibility and dynamic of the environment is critical for

1  
2  
3 firms if they wish to achieve success (Liao and Hu, 2007). Anand and Ward  
4 (2004) show that a good fit between each kind of environment and the  
5 flexibility developed is associated with improvement in performance. The  
6 literature shows that the firm's production strategy will depend critically on  
7 the environment in which it operates (Hill, 2000). But studies like that by  
8 Eisenhardt and Schoonhoven (1990), in which we find organizational  
9 flexibility is the response to dynamism of the environment, explain why we  
10 consider that dynamism of the environment can be a variable moderating  
11 the relation between strategic behaviours.

12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
Dynamism of the environment means that current products and services  
quickly become obsolete due to changes in technologies, change in  
customers' tastes, and the fluctuation of supply and demand of materials,  
leading to the development of new ones (Jansen *et al.*, 2005). To resolve  
this problem, firms should introduce innovations on the market, whether  
they are incremental or radical. In fact, Jansen *et al.* (2006) have already  
introduced dynamism of the environment as a moderating variable in the  
relation of strategic behaviours to entrepreneurial performance, enabling us  
to understand and extend the variable to our relation between  
manufacturing flexibility and the firm's strategic behaviour.

**H3.** *Dynamism of the environment moderates the relation between  
manufacturing flexibility and exploration and exploitation.*

**H3a.** *Dynamism of the environment moderates the relation between  
manufacturing flexibility and exploration in organizations.*

**H3b.** *Dynamism of the environment moderates the relation between  
manufacturing flexibility and exploitation in organizations.*

Organizations' absorption capacity determines their ability to learn, that  
is, "the ability to assimilate and apply new knowledge to adapt to new  
conditions" (Dixon *et al.*, 2007), whereas the concepts of exploration and  
exploitation that we consider are strategic options that the firm possesses to act in  
response to its competitors (Li et al., 2008). The concepts of exploratory and  
exploitative learning (March, 1991) have emerged as two premises of

1  
2  
3 organizational learning that enable the firm to adapt (Gupta *et al.*, 2006).  
4  
5 Finally, organizations need to learn to adapt to their environment, such that  
6  
7 learning constitutes the correct organizational response to existing  
8  
9 uncertainty (Lei *et al.*, 1996).

10  
11 García-Morales *et al.* (2007) believe that the fundamental role of  
12  
13 learning mechanisms consists of modifying existing knowledge in order to  
14  
15 adapt to the competitive environment. Within the process of regenerating  
16  
17 organizational knowledge proposed by these authors, we can find that  
18  
19 renovating organizational knowledge means combining the phases of  
20  
21 *exploration* and *exploitation* of existing knowledge, which strengthens this  
22  
23 relation.

24  
25 According to Dixon, *et al.* (2007), exploratory learning facilitates  
26  
27 strategic flexibility, as it enables development of new endogenous abilities,  
28  
29 thereby encouraging development of sustainable competitive advantages.  
30  
31 We thus believe that organizational learning is a variable moderating the  
32  
33 relation between manufacturing flexibility and strategic behaviour in the  
34  
35 firm.

36  
37 **H4.** *Organizational learning in the firm moderates the relation between*  
38  
39 *manufacturing flexibility and exploration and exploitation.*

40  
41 **H4a.** *Organizational learning in the firm moderates the relation*  
42  
43 *between manufacturing flexibility and exploration.*

44  
45 **H4b.** *Organizational learning in the firm moderates the relation*  
46  
47 *between manufacturing flexibility and exploitation.*

## 50 **5. Sample and methods**

### 51 52 53 5.1. Sample

54  
55  
56 To carry out the empirical study, we have used the SABI database to  
57  
58 focus on firms in the Spanish production sector (without small companies).  
59  
60 We obtained a population of 2000 firms, which is reduced through simple  
random sampling to 1850.

1  
2  
3 The information was obtained through a structured telephone  
4 questionnaire administered directly to the CEOs of the firms involved during  
5 June 2008. We obtained a total of 231 valid questionnaires, a global  
6 response rate of 12.46%. The sample error, taking an infinite population, is  
7 6.1%, providing a confidence level of 95%. We compared the mean value of  
8 the size variables between all firms and those included in the sample and  
9 obtained similar values in both cases. We can thus affirm that firms that do  
10 not respond to the questionnaire do not introduce significant bias into the  
11 final results of the study and that there is no reason not to extrapolate from  
12 the results to the total population.  
13  
14  
15  
16  
17  
18  
19  
20  
21

## 22 5.2. Measurement

23  
24  
25 To confirm that each group of indicators explains only one practice, we  
26 perform an exploratory factor analysis. From the exploratory factor analysis  
27 performed on each group of items, we see that each of the resulting  
28 indicators measures a single variable, enabling us to confirm the  
29 unidimensionality of the scales. We then performed a confirmatory factor  
30 analysis to analyze the significance of the factor loading to determine  
31 whether it is greater than 0.4 (Hair et al., 2004) and, finally, to determine  
32 whether the value of individual reliability ( $R^2$ ) is higher than 50%. In this  
33 case, we can see that all of the indicators fulfil the three conditions cited.  
34 Fulfilling these three requirements ensures the convergent validity of the  
35 indicators used.  
36  
37  
38  
39  
40  
41  
42  
43

44 Next, we examine the discriminant validity of the measurement scales.  
45 To do this, we compare the correlation value observed in the confirmatory  
46 factor analysis with the correlation value calculated for a perfect correlation.  
47 We can see that in no case does the correlation observed exceed the value  
48 calculated, thus ensuring discriminant validity.  
49  
50  
51  
52  
53

### 54 5.2.1. Exploitation and exploration capacity

55 Our measures of exploration and exploitation capacity are based on the  
56 scale developed by Jansen, et al. (2006). To measure exploration, we used  
57 five items related to experimentation with ideas, technologies, strategies,  
58 and new knowledge. To measure exploitation, we used six items related to  
59  
60



1  
2  
3 ideas, technologies, strategies and existing knowledge. The Cronbach's  
4 alpha is 0.92, indicating the scale's reliability. To ensure unidimensionality,  
5 we checked that all items loaded on a single factor.  
6  
7  
8  
9

### 10 5.2.2. Manufacturing flexibility

11 To measure the flexibility variables, we reviewed the different studies  
12 that have developed scales to measure the dimensions of manufacturing  
13 flexibility. We have chosen six measurement scales from those proposed in  
14 the literature, the first five from Larso (2004), and the last from Koste and  
15 Malhotra (2004): modification flexibility, routing, sequence, material  
16 handling, machines and mix flexibility. To measure these dimensions, as well  
17 as the other variables, we asked the company CEOs to indicate on a Likert-  
18 type 1-7-point scale (1="totally disagree", 7="totally agree") their degree  
19 of agreement or disagreement with the items proposed.  
20  
21  
22  
23  
24  
25  
26  
27

28 The scale's internal consistency and reliability were studied. Factor  
29 analysis showed that the items loaded on a single factor, which provides  
30 proof of unidimensionality. The Cronbach's alpha values for internal  
31 consistency were modification flexibility (0.892), routing flexibility (0.832),  
32 sequence flexibility (0.739), material handling flexibility (0.863), machine  
33 flexibility (0.872) and mix flexibility (0.925).  
34  
35  
36  
37  
38  
39  
40

### 41 5.2.3. Organizational learning

42 The capability of organizational learning has received much more  
43 theoretical attention than empirical. Dixon et al. (2007) defined it as "the  
44 ability to assimilate and apply new knowledge to adapt to new conditions".  
45 Additionally, previous measures have wide differences among their  
46 assumptions, procedures, and objectives. We chose the scale developed by  
47 Kale et al. (2000) due to the fact that there is a closer link with this  
48 research, that they reflected the different prior trends well and that the  
49 scale's validity was verified in detail. We used the first two items from this  
50 scale and added two additional items based on Edmondson's (1999) work to  
51 compose a multi-item scale of organizational learning. These items have  
52 been duly adapted to the present study. Its reliability was analyzed (0.912),  
53 as was the unidimensionality.  
54  
55  
56  
57  
58  
59  
60

#### 5.2.4. Dynamism of the environment

There are different studies that synthesize the different dimensions of the environment (Aldrich, 1979; Sharfman and Dean, 1997). In these studies we find dimensions such as dynamism, complexity or munificence. We focus on dynamism, since it is the dimension that affects flexible environments directly (Sorensen and Stuart, 2000). We use the four items of the scale on dynamism of the environment proposed by Miller and Friesen (1983), which defines dynamism as the degree of instability of the factors that affect the environment of the firm. Unidimensionality was studied, as was the internal consistency (0.796).

## 6. Results

In order to test the hypotheses, we first analyze the contingency tables to determine the relation between the strategic behaviours, to establish whether both can occur in the firm. Second, we used hierarchical regression analysis to analyze the moderating effect of organizational learning and dynamism of the environment on the relation between manufacturing flexibility and the firm's strategies of exploration and exploitation. To confirm whether the moderating effects are significant, we first estimate the regression model, which includes dynamism of the environment and the firm's organizational learning as explanatory variables. We then introduce the dimensions of manufacturing flexibility. Finally, we introduce the terms of the interactions or moderating effects to estimate whether each inclusion causes a significant change in  $R^2$ .

The verification of Hypothesis 1 was performed using the contingency tables. The results of the  $X^2$  statistics are shown in Table 1. After relating each of the items, according to the recommendations of Hair *et al.* (2004), we can see that over 50% of the firms that believe the innovation of their products and services is high believe that the development of their intrinsic abilities is also high; that is, over 50% of the organizations that explore new knowledge also exploit their abilities. Through the study of the significance of  $X^2$  in each of the contingency tables, we confirm that we must reject the hypothesis that exploration and exploitation are independent, since in all of

1  
2  
3 the cases the value of  $p$  is less than 0.005. We can thus say that there is a  
4 relationship of dependence between exploration and exploitation. This  
5 enables us to confirm Hypothesis 1, which proposes the compatibility of the  
6 strategic behaviours in the framework of production firms.  
7  
8  
9

### 10 11 **Table 1: X<sup>2</sup> Statistic**

12  
13  
14  
15 The three following hypotheses will be developed by studying a linear  
16 regression with moderating variables (George, 2003). We will perform the  
17 regression first on the dependent variable exploration (Table 2) and then on  
18 exploitation (Table 3). The descriptive analysis and the correlation are  
19 shown in the Appendix, which also provides the reliability of the different  
20 scales.  
21  
22  
23  
24

25  
26 Hypothesis 2 suggests that production flexibility influences the firm's  
27 exploration and exploitation. In Table 2, we see that the change in  $R^2$  is  
28 significant, as there is an increase of 3% in the variance, with a significance  
29 level of 0.003, or 99%. Table 3 includes the effect of manufacturing  
30 flexibility on exploitation. We can see that the change in  $R^2$  is less, although  
31 still significant at 99%, with an increase of 1.2% in the variance. Through  
32 these results, we can confirm Hypothesis 2, which proposes the influence of  
33 the implementation of manufacturing flexibility on the development of  
34 exploration and/or exploitation.  
35  
36  
37  
38  
39  
40

41 The verification of this hypothesis strengthens the validity of Hypothesis  
42 1, which treated the compatibility of strategic behaviour in the organization,  
43 as we can see that the implementation of manufacturing flexibility benefits  
44 the development of exploration and exploitation together, implying that  
45 these two behaviours can be developed simultaneously.  
46  
47  
48  
49

50 Table 2 in turn includes the moderating effects of dynamism of the  
51 environment and organizational learning on the exploration of new  
52 knowledge and abilities. When we introduce the moderating effects of  
53 learning and dynamism of the environment on the dimensions, we see that  
54 the data improve significantly, as adjusted  $R^2$  increases to 13.4% and the  
55 change as compared to the third model is 5.6%.  
56  
57  
58  
59

60 We should mention the importance that learning and dynamism of the  
environment possess in this relationship. In the three models, we find

1  
2  
3 significant data in the relation between dynamism of environment and the  
4 exploration of new knowledge and that favour as a moderating factor in the  
5 relation of routing and sequence flexibility with the exploration, -1.999 and  
6 2.005, respectively (significant for a confidence level of 95%). This enables  
7 us to confirm some of our hypotheses, such as H3a and H4a.  
8  
9  
10  
11  
12

### 13 **Table 2: Effect of MF on Exploration**

14  
15  
16  
17  
18 In Table 3 we explain the relationships of the organizational learning and  
19 dynamism of the environment with exploitation and whether or not they  
20 affect as moderating variables the relationship between manufacturing  
21 flexibility and the exploitation of the firm's abilities.  
22  
23

24  
25 We can see that the total increase in the  $R^2$  statistic is 5.9% from the  
26 initial model, in which we only introduced organizational learning and  
27 dynamism of the environment as explanatory variables, to the third model,  
28 in which we include these first two variables plus the dimensions of  
29 manufacturing flexibility and the moderating effects that the first two  
30 variables have on manufacturing flexibility.  
31  
32

33  
34  
35 Another significant data is that dynamism of the environment does not  
36 produce significant numbers, although the theory makes us expect that it  
37 would. In addition, we find significant results that show a moderating  
38 relation of dynamism to some of the dimensions of manufacturing flexibility  
39 and exploitation of workers' abilities, as in the case of manufacturing  
40 sequence and machine flexibility. Thus, the total effect (or regression  
41 coefficient) of machine flexibility on exploitation of abilities will be:  $0.017 +$   
42  $0.148 \times D$  (according to Hair, *et al.*, 2004).  
43  
44

45  
46  
47 Among the nonsignificant results, we should mention the number of  
48 dimensions that have the opposite effect when we study the moderating  
49 effect of dynamism of the environment. We can see that modification,  
50 routing, material handling, and mix flexibility have a negative sign. This  
51 means that in dynamic environments, the development of these dimensions  
52 works against exploitation of the firm's abilities.  
53  
54

55  
56  
57 We can show the significance of organizational learning and its  
58 moderating effect on the relation of production process flexibility to  
59  
60

1  
2  
3 exploitation of new knowledge, confirming H4b, such that we can now verify  
4 the whole of H4.  
5  
6  
7

### 8 9 **Table 3: Effect of MF on Exploitation**

## 10 11 12 **7. Discussion and conclusions**

### 13 14 15 *7.1. Discussion*

16  
17  
18  
19  
20 Theory shows us that in order to compete in the unstable environments  
21 of the twenty-first century, firms should both develop research in new  
22 knowledge and ideas and encourage their existing capacities. Our first  
23 hypothesis thus try to resolve the current debate in the literature  
24 concerning whether the two behaviours are compatible in the framework of  
25 a single firm.  
26  
27  
28  
29

30  
31 The results of our study show that organizations that think they have a  
32 high level of innovation, whether in products or production methods, believe  
33 this success to be based on tasks such as the development of activities  
34 oriented to the search for new products, services, processes or markets, to  
35 the revision of these activities, and the firm's adaptation to them.  
36  
37  
38

39  
40 The same firms believe profitable behaviours also include encouraging  
41 the development of each worker's abilities, the capacities that the firm can  
42 achieve by correct functioning, and achieving interaction between all of the  
43 firm's internal parts.  
44

45  
46 Our results justify the proposals of Lavie and Rosenkopf, (2006)  
47 regarding the need for dual organizations or those of Birkinshaw and  
48 Gibson (2004) on ambidextrous organizations, as both theories advocate  
49 the development of both behaviours in the firm, that is, the development of  
50 exploration of new entrepreneurial knowledge and the exploitation of the  
51 firm's common abilities.  
52  
53  
54  
55

56  
57 With Hypothesis 2 we seek to determine whether manufacturing  
58 flexibility enables the development of exploration and exploitation in the  
59 firm. The first contribution we find in our analysis is that manufacturing  
60 flexibility encourages the development of both exploration and exploitation,

1  
2  
3 a fact that is understood by analyzing the goals of both behaviours. The  
4  
5 main goal of exploration is "to find new alternatives that improve what  
6  
7 exists" (March, 1991), taking a long-term perspective of the firm but  
8  
9 without the urgent rush or need for performance (March, 1996). In  
10  
11 contrast, among the variety of ways to conduct exploitation, we consider  
12  
13 one of the main activities to be the search for new routes and the  
14  
15 elimination of deficient tasks (Levinthal and March, 1993), identifying this  
16  
17 as a short-term objective to obtain benefits for the organization.

18  
19 Through the last two hypotheses, we have attempted to study whether  
20  
21 the nature of the environment and organizational learning take part to block  
22  
23 or to drive the implementation of manufacturing flexibility. This  
24  
25 consideration comes from proposals found in the scientific literature, which  
26  
27 explain that organizational learning and dynamism of the environment  
28  
29 affect the implementation of manufacturing flexibility (Sorensen and Stuart,  
30  
31 2000; Nielsen, 2006).

32  
33 Analysing the results, we can see that organizational learning influences  
34  
35 both strategic behaviours positively and significantly. Baum *et al.* (2000)  
36  
37 treat the concepts from this perspective, justifying the importance of  
38  
39 exploration, through experiments planned by the firm for possible changes  
40  
41 in processes, and of exploitation, through the refinement and reuse of  
42  
43 routines. Further, Nielsen (2006) determined that the main knowledge  
44  
45 management activities—such as the creation, integration and exploitation of  
46  
47 the firm's knowledge—can generate flows that modify current knowledge of  
48  
49 organizational resources and capacities. This enables adaptation to the  
50  
51 conditions of the environment, which gives validity the relation we have  
52  
53 found between learning and dynamism and entrepreneurial exploration and  
54  
55 exploitation.

56  
57 We can see in turn that the environment also affects the firm's strategic  
58  
59 behaviour. Eisenhardt and Schoonhoven (1990) study the importance of the  
60  
61 firm's structure and flexibility to adapt to the environment, understanding  
62  
63 that the firm's characteristics will facilitate the different movements of  
64  
65 information, the main source of a firm's nourishment (March, 1991). Within  
66  
67 the dimensions of the environment that can be studied, we have seen that  
68  
69 dynamism facilitates the exploration of new knowledge. This agrees with the  
70  
71 results of Danneels (2002), who concludes that dynamic environments

1  
2  
3 enable greater flows of information between the different parts of the  
4 market, such that workers will have better sources of knowledge.  
5  
6  
7

### 8 *7.2. Conclusions and implications for entrepreneurial management*

9

10 The conclusions obtained in this study should help organizations realize  
11 the imperative need to be flexible in markets in which fast and unexpected  
12 changes require adaptation and response capacity. To support these  
13 changes, firms need to develop a special internal ability to adapt to their  
14 customers' needs. This ability is known as manufacturing flexibility. We  
15 have also observed that organizations and their workers possess different  
16 ways of learning. We find that some firms seek knowledge outside  
17 themselves, investing in external research and development. Others give  
18 their managers and workers free rein to perfect their work methods using  
19 their own knowledge. And of course we find firms that develop both  
20 concepts and seek to improve by finding a balance between these two  
21 possibilities- exploration and exploitation of capacities.  
22  
23  
24  
25  
26  
27  
28  
29

30 The existence of flexibility in the firm's manufacturing and strategic  
31 behaviour has led us to propose two objectives. The first is to verify  
32 whether we can make the two behaviours compatible in the organization.  
33 The second is to contrast whether manufacturing flexibility benefits the  
34 development of these behaviours and whether the way in which the  
35 organization learns and the speed of change in the environment affect this  
36 relation. Hence, the main findings of this research can be outlined as  
37 follows:  
38  
39  
40  
41  
42  
43

44 We were able to establish through contrast that exploration and  
45 exploitation can be compatible in the same organization, as the firms that  
46 explore new external knowledge are those that exploit the abilities of their  
47 own workers to a greater extent.  
48  
49  
50

51 As to the relationship to manufacturing flexibility, we can affirm that its  
52 implementation will enable the development of exploration and exploitation.  
53 If we analyze this relationship in greater depth, we see on the one hand  
54 that dynamism of the environment surrounding the firm will benefit the  
55 development of exploration, as there is more interaction with external  
56 agents. This means greater information flows through which to obtain  
57  
58  
59  
60

1  
2  
3 knowledge. On the other hand, stability of the environment and the  
4 organization's learning capacity will benefit the firm's efforts to exploit their  
5 workers' abilities.  
6  
7

8  
9 In dynamic entrepreneurial environments with constant change,  
10 managers must be able to endow their organization with resources and  
11 capacities that enable the firm to adapt to changes in its customers'  
12 preferences and to exploit the firm's prior knowledge in order to satisfy  
13 demand. Thus, manufacturing flexibility is a basic variable to develop in all  
14 firms that have a transformation or production process. Those responsible  
15 for planning the manufacturing should structure their tasks in a way that  
16 the firm can adapt to changes in the environment.  
17  
18

19  
20 Exploration is linked to and developed through different activities that  
21 increase the organizational processes and risks. In turn, the goal of  
22 exploitation is short term. From a practical point of view, analyzing the  
23 different objectives of exploration and exploitation, managers should keep  
24 in mind the advantages that they can achieve keeping production flexible in  
25 order to combine the two strategic behaviours and obtain the best  
26 performance possible. They obtain this performance through a balance  
27 between long and short term, that is, between exploration and exploitation.  
28 For this reason, our study should help to reinforce acceptance of the need  
29 to increase use of these activities in entrepreneurial environments.  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44

## 45 References

- 46  
47 Aldrich, H.E., 1979. *Organizations and environments*, Englewood Cliffs, New York.  
48  
49 Ali, M. and Wadhwa, S., 2009. The effect of routing flexibility on a flexible system of integrated  
50 manufacturing. *International Journal of Production Research*, Vol. 1, 1-19, iFirst.  
51  
52 Anand, G. and Ward, P., 2004. Fit, Flexibility and Performance in Manufacturing: Coping with  
53 Dynamic Environments. *Production and Operations Management*, Vol. 13, 369-387.  
54  
55 Barad, M. and Hoang, K., 1996. Cutting tools versus machine tools investments in FMS design.  
56 *International Journal of Production Economics*, Vol 42, 29-43.  
57  
58 Baum, J.A.C., Li, S.X. and Usher, J.M., 2000. Making the next move: How experiential and  
59 vicarious learning shape the locations of chains' acquisitions. *Administrative Science*  
60 *Quarterly*, Vol 45, 766-801.



- 1  
2  
3 Baykasoğlu, A., 2009. Quantifying machine flexibility. *International Journal of Production*  
4 *Research*, Vol 47, 4109-4123.
- 6 Beach, R.A.P., Muhlemann, D.H.R., Price, A., Paterson, M. and Sharp, J.A., 2000. A review of  
7 manufacturing flexibility. *European Journal of Operational Research*, Vol 122, 41-57.
- 9 Beckman, C., Haunschild, P. and Philips, D., 2004. Friends or strangers? Firm-specific  
10 uncertainty, market uncertainty, and network partner selection. *Organization Science*, Vol  
11 15, 259- 275.
- 13 Beckman, C., 2006. The influence of founding team company affiliations on firm behaviour.  
14 *Academy of Management Journal*, Vol 49, 741-758.
- 16 Benner, M.J. and Tushman, M.L., 2002. Process management and technological innovation: A  
17 longitudinal study of the photography and paint industries. *Administrative Science Quarterly*,  
18 Vol 47, 676-706.
- 20 Birkinshaw, J. and Gibson, C., 2004. Building ambidexterity into an organisation. *MIT Sloan*  
21 *Management Review*, Summer, 47-55.
- 23 Boer, H. and Laugen, B., 2008. Continuous innovation managing dualities through coordination.  
24 *International Journal of Technology Management*, Vol 44, 328-343.
- 26 Burgelman, R.A., 2002. Strategy as vector and the inertia of coevolutionary lock-in.  
27 *Administrative Science Quarterly*, Vol 47, 325-340.
- 29 Chang, S., Chen, R., Lin, R., Tien, S. and Sheu, C., 2006. Supplier involvement and  
30 manufacturing flexibility. *Technovation*, Vol 26, 1136–1146.
- 32 Chen, I.J. and Chung, C.H., 1992. Effects of loading and routing decisions on performance of  
33 flexible manufacturing systems. *International Journal of Production Research*, Vol 29, 2209-  
34 2225.
- 36 Christensen, C.M., 1998. *The innovator's dilemma*, Boston: Harvard Business School Press.
- 38 Cox, T., 1989. Towards the measurement of manufacturing flexibility. *Production and Inventory*  
39 *Management Journal*, Vol 30, 68-72.
- 41 Danneels, E., 2002. The dynamics of product innovation and firm competences. *Strategic*  
42 *Management Journal*, Vol 23. 1095-121.
- 44 Danneels, E., 2004. Disruptive technology reconsidered: A critique and research agenda.  
45 *Journal of product innovation management*, Vol 21, 246-52.
- 47 Das, K. and Narasimhan, R., 1999. An empirical investigation of the contribution of strategic  
48 sourcing to manufacturing flexibilities and performance. *Decision Sciences*, Vol 30, 683.
- 50 De Toni, A. and Tonchia, S., 1998. Manufacturing flexibility: a literature review. *International*  
51 *Journal of Production Research*, Vol 36, 1587-1617.
- 53 Debenham, J. and Wilkinson, I., 2006. Exploitation versus Exploration in Market Competition.  
54 *Industry and Innovation*, Vol 13, 263-285.
- 56 Dixon, S., Meyer, K. and Day, M., 2007. Exploitation and exploration learning and the  
57 development of organizational capabilities: A cross-case analysis of the Russian oil  
58 industry. *Human Relations*, Vol 60, 1493.
- 60

- 1  
2  
3 Edmondson, A., 1999. Psychological Safety and Learning Behaviour in Work Teams.  
4 *Administrative Science Quarterly*, Vol 44, 350-383.
- 6 Eisenhardt, K. and Schoonhoven, C., 1990. Organizational Growth: Linking founding teams,  
7 strategy, environment, and growth among U.S. semiconductor ventures. *Administrative*  
8 *Science Quarterly*, Vol 34, 504-529.
- 10 García-Morales, V., Lloréns-Montes, F.J. and Verdú, A., 2007. Influence of personal mastery on  
11 organizational performance through organizational learning and innovation in large firm and  
12 SMEs. *Technovation*, Vol 27, 547–568.
- 14 Garrett, S.E., 1986. *Strategy first: A case in FMS justification*. Operation Research, Conference  
15 on flexible manufacturing systems, Amsterdam.
- 17 George, E., 2003. External solutions and internal problems: The effects of employment  
18 externalization on internal workers' attitude. *Organization Science*, Vol 14, 386-402
- 20 Gerwin, D., 1993. Manufacturing flexibility: a strategic perspective. *Management Science*, Vol  
21 39, 395-410.
- 23 Gerwin, D., 2005. An agenda for research on the flexibility of manufacturing processes.  
24 *International Journal of Operations and Production Management*, Vol 25, 1171-1182.
- 26 Greve, H., 2007. Exploration and exploitation in product innovation. *Industrial and Corporate*  
27 *Change*, Vol 16, 945-976.
- 29 Gupta, Y., 1988. Organizational issues of flexible manufacturing systems. *Technovation*, Vol 8,  
30 255-269.
- 32 Gupta, D., 1993. On measurement and valuation of manufacturing flexibility. *International*  
33 *Journal of Production Research*, Vol 31, 2947-2958.
- 35 Gupta, Y. and Somers, T., 1992. The Measurement of Manufacturing Flexibility. *European*  
36 *Journal of Operational Research*, Vol 60, 166-183.
- 38 Gupta, K., Smith, G. and Shalley, E., 2006. The interplay between exploration and exploitation.  
39 *Academy of Management Journal*, Vol 49, 693-712.
- 41 Hamel, G., 2006. The why, what and how of management innovation. *Harvard Business*  
42 *Review*, Vol 84, 72-84.
- 44 Hair, J.F., Anderson, R.E., Tatham, R.L. and Black, W.C., 2004. *Análisis multivariante*, Prentice  
45 Hall, Madrid.
- 47 Hayes, R. and Wheelwright, S., 1984. *Restoring Our Competitive Edge*. Wiley, New York.
- 49 Hill, T., 2000. *Manufacturing Strategy: Text and Cases*. McGraw Hill, Boston, Massachusetts.
- 51 Jansen, J., Van Den Bosch, F. and Volberda, H., 2005. Managing potential and realized  
52 absorptive capacity: How do organizational antecedents matter?. *Academy of Management*  
53 *Journal*, Vol. 48, 999–1015.
- 55 Jansen, J., Van Den Bosch, F. and Volberda, H., 2006. Exploratory Innovation, Exploitative  
56 Innovation, and Performance: Effects of Organizational Antecedents and Environmental  
57 Moderators. *Management Science*. 52, 1661–1674.
- 59  
60

- 1  
2  
3 Kale, P., Singh, H. and Perlmutter, H., 2000. Learning and Protection of Proprietary Assets in  
4 Strategic Alliances: Building Relational Capital. *Strategic Management Journal*. 21, 217-  
5 317.  
6  
7 Kettunen, P., 2009. Adopting key lessons from agile manufacturing to agile software product  
8 development- A comparative study. *Technovation*. 29, 408-429.  
9  
10 Koste, L.L. and Malhotra, M.K., 1999. A theoretical framework for analyzing the dimensions of  
11 manufacturing flexibility. *Journal of Operations Management*. 18, 75-93.  
12  
13 Koste, L.L. and Malhotra, M.K., 2004. Measuring dimensions of manufacturing flexibility. *Journal*  
14 *of Operations Management*. 22, 171-195.  
15  
16 Larso, D., 2004. *Manufacturing flexibility in new product development: Perceptions and*  
17 *implications of new product performance*. Oregon State University.  
18  
19 Lavie, D. and Rosenkopf, L., 2006. Balancing exploration and exploitation in alliance formation.  
20 *Academy of Management Journal*. 49, 797-818.  
21  
22 Lei, D., Hitt, M. and Bettis, R., 1996. Dynamic core competences through meta-learning and  
23 strategic context. *Journal of Management*. 15, 549-570.  
24  
25 Leong, G., Snyder, D. and Ward, P., 1990. Research in the process and content of  
26 manufacturing flexibility. *Omega*. 18, 109-122.  
27  
28 Levinthal, D.A. and March, J.G., 1993. The myopia of learning. *Strategic Management Journal*.  
29 14, 95-112.  
30  
31 Li, C., Lin, C. and Chu, C., 2008. The nature of market orientation and the ambidexterity of  
32 innovations. *Management Decision*. 46, 1002-1026.  
33  
34 Liao, H. and Hu, T., 2007. Knowledge transfer and competitive advantage on environmental  
35 uncertainty: An empirical study of the Taiwan semiconductor industry. *Technovation*. 27,  
36 402-411.  
37  
38 Llorens-Montes, J., Garcia-Morales, V. and Verdú, A., 2004. Flexibility and quality management  
39 in manufacturing: an alternative approach. *Production Planning and Control*. 15, 525-533.  
40  
41 Mandelbaum, M., 1978. *Flexibility in decision making: an exploration and unification*. PhD  
42 thesis, Department of Industrial Engineering, University of Toronto, Toronto.  
43  
44 March, J.G., 1991. Exploration and exploitation in organizational learning. *Organization*  
45 *Science*. 2, 71-87.  
46  
47 March, J.G., 1996. Continuity and change in theories of organizational action. *Administrative*  
48 *Science Quarterly*. 41, 278-287.  
49  
50 Miller, K.D. and Friesen, P., 1983. Strategy making and environment: The third link. *Strategic*  
51 *Management Journal*, Vol 4, 221-235.  
52  
53 Miller, J.G. and Roth, A.V., 1994. A taxonomy of manufacturing strategies. *Management*  
54 *Science*, Vol 40, 285-304.  
55  
56 Miller, K.D., Zhao, M. and Calantone, R., 2006. Adding interpersonal learning and tacit  
57 knowledge to March's exploration-exploitation model. *Academy of Management Journal*,  
58 Vol 49, 709-722.  
59  
60

- 1  
2  
3 Mintzberg, H., 1980. Structure in 5's: A synthesis of the research in organization design.  
4 *Management Decision*, Vol 26, 322-341.
- 5  
6 Nahm, A., Vonderebse, M. and Koufteros, X., 2003. The impact of organizational structure on  
7 time based manufacturing and plant performance. *Journal of Operation Management*, Vol  
8 21, 281-306.
- 9  
10 Nielsen, A.P., 2006. Understanding dynamic capabilities through knowledge management.  
11 *Journal of knowledge*, Vol 10, 59-77.
- 12  
13 Petroni, A. and Bevilacqua, M., 2002. Identifying manufacturing flexibility best practices in small  
14 and medium enterprises. *International Journal of Operations and Production Management*,  
15 Vol 22, 929-952.
- 16  
17  
18 Qian, B., Wang, L., Huang, D. X. and Wang, X, 2007. An effective hybrid DE-based algorithm  
19 for flow shop scheduling with limited buffers. *International Journal of Production Research*,  
20 Vol 47, 1, 24 .
- 21  
22 Sethi, A. and Sethi, S., 1990. Flexibility in manufacturing: a survey. *The International Journal of*  
23 *Flexible Manufacturing Systems*, Vol 2, 289-328.
- 24  
25 Sharfman, M. and Dean, J., 1997. Flexibility in strategic decision making: Informational and  
26 ideological perspectives. *The Journal of Management Studies*, Vol 34, 191-217.
- 27  
28 Siggelkow, N. and Levinthal, D., 2003. Temporarily divide to conquer: Centralized,  
29 decentralized, and reintegrated organizational approaches to exploration and adaptation.  
30 *Organization Science*, Vol 14, 650-669.
- 31  
32 Slack, N., 2005. The changing nature of operations flexibility. *International Journal of*  
33 *Operations and Production Management*, Vol 25, 1201-1225.
- 34  
35 Sorensen, J.B. and Stuart, T.E., 2000. Aging, obsolescence and organizational innovation.  
36 *Administrative Science Quarterly*, Vol 45, 81-113.
- 37  
38 Taylor, A. and Greve, H., 2006. Superman or the fantastic our? Knowledge combination and  
39 experience in innovative teams. *Academy of Management Journal*, Vol 49, 723-740.
- 40  
41 Treville, S., Bendaham, S. and Van der Haeghe, H., 2007. Manufacturing flexibility and  
42 performance: bridging the gap between theory and practice. *International Journal of Flexible*  
43 *Manufacturing Systems*, Vol. 19, 334-357
- 44  
45 Upton, D., 1994. The management of manufacturing flexibility, *California Management Review*,  
46 Winter, 72-89.
- 47  
48 Van Hop, N. and Ruengsak, K., 2005. Fuzzy estimation for manufacturing flexibility.  
49 *International Journal of Production Research*, Vol 43, 3605-3617.
- 50  
51 Wadhwa, S. and Madhawanand, M., Felix, C., 2009. Organizing a virtual manufacturing  
52 enterprise: an analytic network process based approach for enterprise flexibility.  
53 *International Journal of Production Research*, Vol 47, 163-186.
- 54  
55 Wahab, M. I., 2005. Measuring machine and product mix flexibilities of a manufacturing system.  
56 *International Journal of Production Research*, Vol 43, 3773-3786
- 57  
58 Wang, L., Kuo, H., Yang, L. and Ding, C., 2006. Flexibility and Performance of MNEs: Evidence  
59 from Taiwan. *International Journal of Business*, Vol 11, 417-431.
- 60

- 1  
2  
3 Zhang, Q., 2001. *Technology infusion-enabled value chain flexibility: A learning and capability-*  
4 *based perspective*. The University of Toledo.  
5  
6 Zhang, Q. and Vonderembse M.A., Lim, J. 2003. Manufacturing flexibility: defining and  
7 analyzing relationships among competence, capability, and customer satisfaction. *Journal*  
8 *of Operations Management*, Vol 21, 173-200.  
9  
10 Zollo, M. and Winter, S.G., 2002. Deliberate learning and the evolution of dynamic capabilities.  
11 *Organization Science*, Vol 13, 339-351.  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

For Peer Review Only

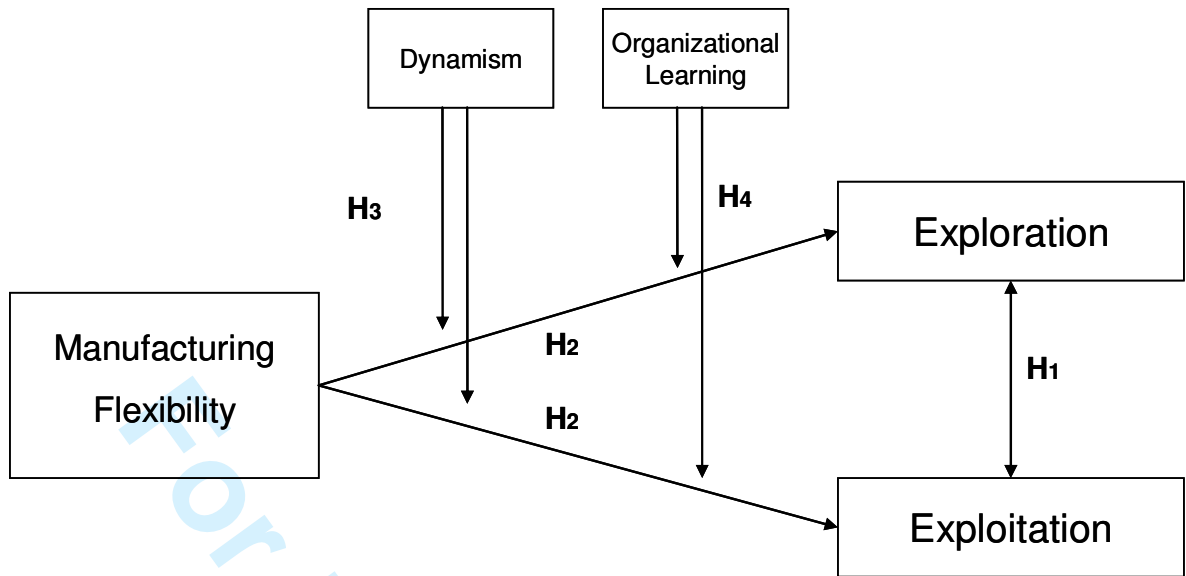


Figure 1: Theoretical model

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47

Table 1:  $\chi^2$  statistic

	EXT 1		EXT 2		EXT 3		EXT 4		EXT 5		EXT 6	
EXR 1	82.212	0.000	96.875	0.000	68.962	0.001	78.636	0.000	93.260	0.000	69.120	0.001
EXR 2	100.783	0.000	131.242	0.000	114.791	0.000	78.871	0.000	107.514	0.000	68.269	0.001
EXR 3	84.974	0.000	99.547	0.000	108.819	0.000	74.140	0.000	73.653	0.000	65.523	0.002
EXR 4	83.736	0.000	90.843	0.000	92.093	0.000	107.587	0.000	102.157	0.000	80.465	0.000
EXR 5	80.596	0.000	101.460	0.000	100.292	0.000	104.091	0.000	111.884	0.000	72.486	0.000

Confidence interval 99%

For Peer Review Only

Table 2: Effect of MF on Exploration

Variable	Model 1		Model 2		Model 3	
(Constant)	3.828***	(8.496)	2.829***	(5.227)	2.677***	(4.539)
DYN	0.165**	(2.331)	0.137**	(1.835)	0.170**	(2.200)
ORG LEAR	0.138**	(1.944)	0.087	(1.183)	0.171**	(2.051)
MOD			0.001	(0.009)	0.023	(0.298)
ROUT			0.150**	(1.950)	0.101	(1.279)
SEQ			0.040	(0.528)	-0.015	(-0.192)
MAT			0.124	(1.548)	0.129	(1.554)
MAC			-0.025	(-0.330)	-0.001	(-0.018)
MIX			0.044	(0.594)	-0.028	(-0.348)
MOD x OL					-0.065	(-0.716)
ROUT x OL					-0.105	(-1.145)
SEQ x OL					0.197**	(2.037)
MAT x OL					-0.114	(-1.148)
MAC x OL					-0.024	(-0.256)
MIX x OL					0.062	(0.656)
MOD x D					-0.054	(-0.655)
ROUT x D					-0.168**	(-1.999)
SEQ x D					0.176**	(2.005)
MAT x D					-0.044	(-0.480)
MAC x D					0.035	(0.432)
MIX x D					-0.069	(-0.853)
F	5.903***		3.101***		2.554***	
Adjusted R <sup>2</sup>	0.047		0.078		0.134	
Change in R <sup>2</sup>	0.047		0.031		0.056	

Dependent variable: Exploration

Shows regression coefficients and t-values.

\*p<0.10 \*\*p<0.05 \*\*\*p<0.01



Table 3: Effect of MF on Exploitation

Variable	Model 1		Model 2		Model 3	
(Constant)	3.578***	(10.057)	2.985***	(6.893)	2.786***	(5.901)
ORG LEAR	0.331***	(4.842)	0.290***	(4.061)	0.311***	(3.820)
DYN	0.059	(0.863)	0.035	(0.487)	-0.010	(-0.127)
MOD			0.023	(0.302)	0.034	(0.437)
ROUT			0.153**	(2.052)	0.189**	(2.430)
SEQ			0.030	(0.410)	0.013	(0.166)
MAT			0.086	(1.100)	0.107	(1.320)
MAC			-0.014	(-0.189)	0.017	(0.226)
MIX			-0.041	(-0.569)	-0.072	(-0.914)
MOD x OL					0.117	(1.330)
ROUT x OL					0.119	(1.333)
SEQ x OL					-0.133	(-1.410)
MAT x OL					-0.061	(-0.629)
MAC x OL					0.054	(0.590)
MIX x OL					0.217**	(2.336)
MOD x D					-0.118	(-1.457)
ROUT x D					-0.094	(-1.146)
SEQ x D					0.216**	(2.517)
MAT x D					-0.088	(-0.980)
MAC x D					0.148*	(1.863)
MIX x D					-0.023	(-0.291)
F	13.697***		4.558***		3.075***	
Adjusted R <sup>2</sup>	0.113		0.125		0.172	
Change in R <sup>2</sup>	0.113		0.012		0.047	

Dependent variable: Exploitation

Shows regression coefficients and t-values.

\*p<0.10 \*\*p<0.05 p<0.01

## APPENDIX

## Appendix A: Dimensions of measurement scales for flexibility and manufacturing

Slack (1983)	Browne, <i>et al.</i> (1984)	Sethi and Sethi (1990)	Gupta and Somers (1992)	Hyun and Ahn (1992)	Gerwin (1993)	Upton (1994)	Koste (1999)	Braulia and Petroni (2000)	Vokurka and O'Leary-Kelly (2000)	Larso (2004)
Products	Machine	Machine	Machinery	Labour	Products	Machine	Labour	Machine	Labour	Machine
Volume	Sequence	Material Handling	Material Handling	Machine	Routing	Design	Machine	Mix	Machine	Material Handling
Mix	Process	Sequence	Sequence	Mix	Volume	Products	Material Handling	Products	Material Handling	Sequence
Delivery	Products	Process	Mix	Products	Mix	Routing	Sequence	Routing	Sequence	Products
Quality	Routing	Products	Routing	Routing	Materials	Volume	Products	Volume	Mix	Routing
	Volume	Routing	Volume	Volume		Expansion	Routing		Products	Volume
	Expansion	Volume	Program	Expansion		Program	Volume		Routing	Mix
	Production	Expansion	Market	Program		Mix	Expansion		Volume	Delivery
		Program					Mix		Expansion	
		Production							Program	
		Market							Production	
									Market	
									Delivery	

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47

Appendix B. Correlations and descriptive statistics

Variable	Modification	Routing	Sequence	Material Handling	Machine	Mix	Exploitation	Exploration	Dynamism	Org. Learn.
Mean	3.8668	4.7062	3.6686	4.5018	4.9589	4.1880	5.0373	5.2957	4.3786	5.8274
SD	1.7940	1.4446	1.4031	1.2135	1.5683	1.7876	1.2716	1.0032	1.4934	1.1658
Modification		0.108	0.374	0.019	0.041	-0.004	0.115	0.096	0.351	0.174
Routing			0.215	0.383	0.305	0.196	0.240	0.239	0.122	0.181
Sequence				0.108	0.099	0.210	0.115	0.126	0.156	0.132
Material Handling					0.333	0.347	0.194	0.221	0.077	0.212
Machine						0.100	0.139	0.095	0.008	0.265
Mix							0.060	0.150	0.128	0.112
Exploitation								0.404	0.132	0.344
Exploration									0.196	0.174
Dynamism										0.222

Correlations greater than or equal to 0.16 are significant at  $p < 0.05$ ; correlations greater than or equal to 0.23 are significant at  $p < 0.01$

Review Only

## Appendix C: Multicollinearity statistics

Effect of MF on Exploitation

Variable	Model 1		Model 2		Model 3	
	Tolerance	FIV	Tolerance	FIV	Tolerance	FIV
DYN	,951	1,052	,831	1,203	0.724	1.382
ORG LEAR	,951	1,052	,857	1,168	0.623	1.605
MOD			,754	1,327	0.702	1.424
ROUT			,783	1,276	0.688	1.453
SEQ			,795	1,258	0.722	1.386
MAT			,722	1,385	0.630	1.587
MAC			,813	1,230	0.734	1.362
MIX			,829	1,207	0.665	1.504
MOD x OL					0.533	1.877
ROUT x OL					0.518	1.932
SEQ x OL					0.463	2.160
MAT x OL					0.437	2.287
MAC x OL					0.492	2.031
MIX x OL					0.479	2.089
MOD x D					0.628	1.593
ROUT x D					0.616	1.622
SEQ x D					0.561	1.783
MAT x D					0.517	1.933
MAC x D					0.658	1.519
MIX x D					0.668	1.497

Effect of MF on Exploration

Variable	Model 1		Model 2		Model 3	
	Tolerance	FIV	Tolerance	FIV	Tolerance	FIV
DYN	0.951	1,052	0.831	1,203	0.724	1.382
ORG LEAR	0.951	1,052	0.857	1,168	0.623	1.605
MOD			0.754	1,327	0.702	1.424
ROUT			0.783	1,276	0.688	1.453
SEQ			0.795	1,258	0.722	1.386
MAT			0.722	1,385	0.630	1.587
MAC			0.813	1,230	0.734	1.362
MIX			0.829	1,207	0.665	1.504
MOD x OL					0.533	1.877
ROUT x OL					0.518	1.932
SEQ x OL					0.463	2.160
MAT x OL					0.437	2.287
MAC x OL					0.492	2.031
MIX x OL					0.479	2.089
MOD x D					0.628	1.593
ROUT x D					0.616	1.622
SEQ x D					0.561	1.783
MAT x D					0.517	1.933
MAC x D					0.658	1.519
MIX x D					0.668	1.497

## Appendix D: Questionnaire.

## PART I: MANUFACTURING FLEXIBILITY

Please indicate the degree you disagree or agree which each statemente regarding the flexibility of your manufacturing plant:

Strongly disagree = 1	2	3	4	5	6	7= Strongly agree
-----------------------	---	---	---	---	---	-------------------

<b>Modification flexibility</b>	
1. Existing products lines are frequently modified.	1 2 3 4 5 6 7
2. There are a large number of modified products produced each year.	1 2 3 4 5 6 7
3. The features of existing products are often modified.	1 2 3 4 5 6 7
4. Modified products can be made quickly.	1 2 3 4 5 6 7
<b>Routing flexibility</b>	
1. A route can process products/parts, which differ greatly to one another.	1 2 3 4 5 6 7
2. A route can process a variety of product/parts.	1 2 3 4 5 6 7
3. Route changes can be made quickly..	1 2 3 4 5 6 7
4. Alternate routes do not increase costs.	1 2 3 4 5 6 7
5. Alternate routes do not decrease quality of products/parts.	1 2 3 4 5 6 7
<b>Sequence flexibility</b>	
1. The ordering of several operations for a part/product type can be done in many different ways.	1 2 3 4 5 6 7
2. There are a large number of interchanges or substituions of operations.	1 2 3 4 5 6 7
3. There is a large variety of interchanges or substituions of operations.	1 2 3 4 5 6 7
4. Alternate sequencing plans do not increase costs.	1 2 3 4 5 6 7
<b>Material handling flexibility</b>	
1. The material handling system can transport materials of different sizes.	1 2 3 4 5 6 7
2. The materials handling system can transport a wide variety of materials.	1 2 3 4 5 6 7
3. Changing a material handling path is inexpensive.	1 2 3 4 5 6 7
4. Changing a material handling path is quick.	1 2 3 4 5 6 7
5. The choice of material handling path does not affect the material transfer time.	1 2 3 4 5 6 7
6. The choice of material handling path does not affect the efficiency of material transfer.	1 2 3 4 5 6 7
7. The choice of material handling path does not affect the material transfer cost (in €).	1 2 3 4 5 6 7
<b>Machine flexibility</b>	
1. Typical machines can use many different tools.	1 2 3 4 5 6 7
2. Machines can perform operations, which are not very similar to one another.	1 2 3 4 5 6 7
3. Machines can perform a high variety of operations.	1 2 3 4 5 6 7
4. Machines produce equal quality for all operations.	1 2 3 4 5 6 7
5. Machines are equally reliable for all operations.	1 2 3 4 5 6 7

**Process flexibility**

1. The processing requirements for the products produced in the plant vary greatly from one product to another.	1	2	3	4	5	6	7
2. The material requirements for the products produced in the plant vary greatly from one product to another.	1	2	3	4	5	6	7
3. The product mix produced by the plant can be changed easily.	1	2	3	4	5	6	7
4. The manufacturing system can quickly changeover to a different product mix.	1	2	3	4	5	6	7
5. Productivity levels are not affected by changes in product mix.	1	2	3	4	5	6	7
6. The performance of the system is not affected by changes in product mix.	1	2	3	4	5	6	7

**PART II: EXPLORATION AND EXPLOITATION ACTIVITIES**

Please indicate the degree you disagree or agree which the following steps the activities of your company last year:

**Strongly disagree = 1 | 2 | 3 | 4 | 5 | 6 | 7= Strongly agree**

1. Our activities search for new possibilities with respect to products/services, processes or markets.	1	2	3	4	5	6	7
2. Our activities try to evaluate diverse options with respect to products/services, processes or markets.	1	2	3	4	5	6	7
3. Our activities are focused on strong renewal of products/services or processes.	1	2	3	4	5	6	7
4. Our activities require quite some adaptability of ourself.	1	2	3	4	5	6	7
5. Our activities require you to learn new skills or knowledge.	1	2	3	4	5	6	7
1. We develop activities of which a lot of experience has been accumulated by yourself.	1	2	3	4	5	6	7
2. We develop activities which serve existing (internal) customers with existing services/products.	1	2	3	4	5	6	7
3. We develop activities of which it is clear to us how to conduct them	1	2	3	4	5	6	7
4. We develop activities primarily focused on achieving short-term goals .	1	2	3	4	5	6	7
5. We develop activities which we can properly conduct by using our present knowledge..	1	2	3	4	5	6	7
6. We develop activities which clearly fit into existing company policy.	1	2	3	4	5	6	7

**PART III: ORGANIZATIONAL LEARNING**

Please indicate the degree you disagree or agree which the following steps the activities of your company last year:

**Strongly disagree = 1 | 2 | 3 | 4 | 5 | 6 | 7= Strongly agree**

1. The organization has learned or acquired much new and relevant knowledge over the last three years.	1	2	3	4	5	6	7
2. Organizational members have acquired critical capacities and skills over the last three years.	1	2	3	4	5	6	7
3. The organization's performance has been influenced by new learning it has acquired over the last three years.	1	2	3	4	5	6	7
4. The organization is a learning organization.	1	2	3	4	5	6	7

**PART IV: ENVIRONMENT DYNAMISM**

Please, indicate the rate of change of the environment of your company:

Slow	=1	2	3	4	5	6	7=	High
------	----	---	---	---	---	---	----	------

Dynamism							
1. The rate at which your products and services become outdated is	1	2	3	4	5	6	7
2. The rate of innovation of new products and services is	1	2	3	4	5	6	7
3. The rate of innovation of new operating processes is	1	2	3	4	5	6	7
4. The tastes and preferences of customers in your industry are	1	2	3	4	5	6	7

Or Peer Review Only