An Evolutionary Approach to Innovation Policy Evaluation: Behavioural Additionality and Organisational Routines

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Abstract

An Evolutionary Approach to Innovation Policy Evaluation: Behavioural Additionality and Organisational Routines

A thesis submitted for the degree of
Doctor of Philosophy (PhD)
by
Abdullah Gök
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The concept of behavioural additionality, which was originally associated with the question of “what difference does policy make in the behaviour of the firms it supports?”, has increasingly been used by scholars, evaluators and policy-makers not only in the field of evaluation of innovation policies but also within the context of fundamental discussions of policy rationales. A survey of the evaluation literature concludes that the concept lacks a clear definition and theoretical background as it does not have a unit of analysis. An empirical analysis of the current practice of innovation policy evaluation endorses this finding and outlines the uniqueness of behavioural additionality in terms of its evaluation. A survey of policy discussions around the concept reveals that behavioural additionality has been argued as the hallmark of an evolutionary view in respect of innovation policy. However, the thesis suggests that the concept also lacks an appropriate framework of analysis to accomplish this.

The thesis argues that behavioural additionality should be redefined by using the concept of organisational routines as the unit of analysis and the evolutionary approach as the framework of analysis. To this end, a theoretical and generic approach that conceives behavioural additionality as the government-influenced evolution of organisational routines at the micro, meso and macro levels is devised. The thesis unfolds how behavioural additionality is created by reinforcing ostensive, performative and artefact aspects of routines within firms. The possibility, rationale and evaluation of behavioural additionality are also discussed. Empirically, the thesis applies a plausibility probe that employs two case studies of Turkish TIDEB and British Collaborative R&D programmes to illustrate the micro level of the approach developed.

It is concluded that the proposed approach provides a better theoretical understanding for behavioural additionality, which would increase its impact on policy-making. This new approach also represents a concrete attempt to utilise the framework and unit of analysis of the evolutionary approach in the field of evaluation for the first time.
Declaration

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Yeliz’ime...
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About the Author

Abdullah Gök finished his BSc studies in Economics, specialising in industrial economics and economics of technology, in 2003 at METU, Ankara, Turkey. He was awarded an MSc in Science and Technology Policy Studies in 2006 at the same university with the thesis entitled “The Concept of Behavioural Additionality of Public Support for Private R&D and a Methodological Proposal for an Evaluation Framework in Turkey”.

He was a Researcher (civil servant) at The Scientific and Technological Research Council of Turkey (TUBITAK), the governmental agency responsible for Turkey’s science, technology and innovation policy. Since 2007, he has been working as a Research Assistant at the Manchester Institute of Innovation Research (MIoIR, formerly PREST), where he has been involved in various research projects including INNO-Appraisal, INNO-Policy Trendchart, ERAWATCH and Evaluation of Czech Science Base. As part of his role at MIoIR, he has taught various topics on the MIoIR Executive Short Course on Evaluation of Science and Innovation Policies for the last three years, including a module titled “What Difference Does It Make – Additionality and Problems of Evaluating Change”. He also conducted tutorials for microeconomics and macroeconomics courses for the 1st year undergraduate students at Manchester Business School for five semesters. During his term at MIoIR, he has also been providing external expert advice to the CIA4OPM OMC-Net Project on the governance and usefulness of impact assessments.
Chapter 1: Introduction
1.1. The Concept of Behavioural Additionality

The concept of behavioural additionality was coined in 1995 as a reaction to input-output based logic of evaluation of technology and innovation policies. The originators of the concept called for a new evaluation framework in which policy analysis focuses on the firm itself as opposed to mainstream understanding, which takes the firm as a black-box. They argued that the information concerning the amount that a firm spends more on R&D because of government support (i.e. input additionality) or the amount of outputs it creates with the help of government (i.e. output additionality) are not sufficient to assess the success of a policy or to design a new one. For the first time, they proposed to study what happens inside the firm as a result of the government intervention analytically by asking the question “what difference does policy make in the behaviour of the firms it supports?” (Buisseret et al., 1995).

This call has been influential in the field of technology and innovation policy evaluation, which has been still in its pre-maturation phase compared to both the field of mainstream evaluation and also the literature on technology and innovation policy. The concept of behavioural additionality has been perceived as evidence that the field is gradually maturing by creating its own concepts to evaluate what is important rather than what seems possible. It provided two important opportunities for the field. First, it was an opportunity to connect more closely with the wider technology and innovation policy literature that is quite distinct from other policy areas as regards to the dominance of evolutionary approaches in explaining change. The field of evaluation of technology and innovation policy has been closer to other economic policy areas (i.e. industrial policy) in terms of the mainstream and neoclassical approach and the vocabulary it employed. Behavioural additionality has been one of the first attempts that embraced a more evolutionary and behavioural understanding in line with the wider policy area. Secondly, behavioural additionality represented a leap forward and maturation for the field of the evaluation of technology and innovation policies, which has been lagging behind the mainstream field of the evaluation of policies akin to sociology and psychology. The mainstream evaluation field has been maturing for several decades and has been successful in creating a comprehensive understanding on its own. Behavioural additionality has been one of the first concepts that the field of technology and innovation policy evaluation created without borrowing from other fields.

The economic crisis of 2007 – 2010 has also highlighted the importance of behavioural additionality. As innovation redeemed its role as the most important source of sustainable growth, a consensus on better policies to support innovation has developed. Furthermore, it has been understood that a new approach for policy-making is needed. The OECD Innovation Strategy that was prepared to tackle these challenges, for instance, built on the five principles of “empowering people to innovate”, “unleashing innovations”, “creating and applying knowledge”,

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“applying innovation to address global and social challenges” and “improving the governance and measurement of policies for innovation” (OECD, 2010). The first four of these principles are associated more closely with the fundamental aims of behavioural additionality such as improving opportunities and mending capabilities rather than the conventional notions of creating resources and enhancing incentives. The final one highlighted a need for a better evaluation framework such as behavioural additionality in which a more complete picture of government intervention can be drawn.

Finally, recent developments in the mainstream economics literature and the allied field of evaluation of economic policies have reiterated the need for behavioural additionality. The implicit but rather important change that the mainstream literature has undergone with the advances in behavioural economics highlighted the importance of approaches that have undermined the long-lasting assumption of perfectly rational *homo economicus* (Mueller, 2004). Although this transformation has focused on individual behaviour so far and the neoclassical view towards the firm is yet to be transformed, the fashion of behavioural economics has contributed to a taste towards behavioural explanations in the field of evaluation, which ultimately increased the popularity of behavioural additionality.

Although the concept of behavioural additionality represents an important leap forward for the above reasons, it is not free from misunderstandings. As I will discuss throughout the thesis, behavioural additionality has had many different practical and most often ad-hoc definitions, which are mainly contradictory and inconsistent. There is no consensus in the literature or practice as to what exactly behavioural additionality is, nor is the issue of how to evaluate behavioural additionality resolved. Most often, it has been used as a residual term for effects that conventional evaluation approaches left unexplained. Similarly, as Gok and Edler (2010) point out, it has sometimes been used as an umbrella excuse for under-achievement.

All these problems are due to the fact that the concept lacks a comprehensive and clear theoretical basis. The concept has always been defined ad hoc. This problem of under-theoretisation has also made it difficult to accomplish the aim of connecting better with the wider policy domain, as behavioural additionality could not embrace a true evolutionary approach.
1.2. Aims of the Research, Research Questions and Overview of the Thesis

Within the frame of the picture drawn above, this thesis has two clear aims. The first aim is to understand what exactly behavioural additionality is. This will constitute the first part of the thesis as illustrated in Exhibit 1, which will shed light on the theoretical problems of the concept. To do this, an historical analysis of the concept in the literature is needed to trace back its roots. Similarly, an analysis of the practice as to what kind of methodologies are used as well as how behavioural additionality is defined in real life evaluations must be conducted. Finally, behavioural additionality should be located within policy discussions. These three objectives will constitute Chapters 2, 3 and 4 respectively. These chapters will discuss how and why the concept needs a better unit and framework of analysis. Consequently, Chapter 5 will discuss the suitability of organisational routines as the unit of analysis for behavioural additionality while Chapter 6 will cover the evolutionary approach as the framework of analysis for behavioural additionality.

By outlining the problems of the current understanding of behavioural additionality and by providing suitable conceptual tools to tackle these problems, Part I will shed light on the question of what behavioural additionality is by mostly discussing what behavioural additionality is not and should not be. This will then feed into Part II of this thesis in which the second aim of the thesis, developing a new understanding of behavioural additionality, will be addressed. Chapter 7 will outline the research design. As the design of the research is dependent on the findings of Part I which sets out the problems of the current understanding of behavioural additionality, Chapter 7 will be presented at the beginning of Part II. Chapter 8 will discuss a new understanding of behavioural additionality in which the concept is defined as the government intervention’s influence on the evolution of supported firms’ organisational routines. Chapter 8 will also discuss various other issues such as the possibility of behavioural additionality, the rationale for behavioural additionality and a new approach to evaluate behavioural additionality and hence will include the main discussion of the thesis. Chapter 9 will employ a plausibility probe that studies two different real life innovation policy programmes to illustrate the new understanding developed. Finally, Chapter 10 will conclude by giving an overview, presenting the contributions of the research, and listing further research opportunities.

One further note on the structure of the thesis would be about its shell design. As the thesis attempts to unfold the problems of the concept of behavioural additionality in Part I and develops a new understanding to address these in Part II, some of the argumentation is presented in a shell structure. For instance, Chapter 4 will discuss the concept from the angle of neoclassical and evolutionary / structuralist policy rationales by using primary literature while the evolutionary
approach will be analysed more broadly and in detail in Chapter 6. Similarly, while Chapter 5 will introduce the concept of organisational routines as a unit of analysis, Chapter 9 will revisit the particular issue of the operationalisation of organisational routines to develop an empirical model to capture behavioural additionality. Finally, some sections will include a recap of previously presented arguments to be able present complex issues in an easily readable way.

A final note is about the presentation of the thesis. As the thesis has a complex structure, cover pages are used to separate the parts and chapters. For each of these, the cover page also includes a word cloud, which shows the most frequent 50 words sized according to their frequency, to provide the reader with an initial idea about the scope of the chapter or part. Finally, all of the issues discussed are considered as sections, no matter how concise they are, to ensure that the thesis builds on a logical structure and to be able to give reference to them by using their particular section numbers.
Chapter 1: Introduction

Exhibit 1: Thesis Plan

Chapter 2: BA as a Concept of Innovation Policy

Chapter 3: BA as a Concept of Evaluation Literature

Chapter 4: BA as a Concept of Innovation Policy - Evaluation Practice

Chapter 5: The Concept of Organisational Routines as a Unit of Analysis

Chapter 6: Evolutionary Approach as a Framework of Analysis

Chapter 7: Research Design

Chapter 8: A New Understanding of BA

Chapter 9: An Empirical Application of the New Understanding of BA

Chapter 10: Conclusion

Part I: Behavioural Additioality (BA), Organisational Routines (ORs) and Evolutionary Thinking

Part II: Towards an Evolutionary Understanding of BA
Part I: Behavioural Additionality, Organisational Routines and Evolutionary Thinking
Part I

Chapter 2: Behavioural Additionality as a Concept of Innovation Policy Evaluation Literature
2.1. Introduction

Behavioural additionality is mainly a concept of evaluation of innovation programmes. While it is an innovative concept in terms of its contribution to policymaking and analysis, the first and foremost function of behavioural additionality lies in the domain of evaluation. It has brought an innovative touch to the evaluation debate and largely shaped the orientation of the domain. This is particularly important, as an evaluation concept is perceived as useful to a wide range of audience such as policymakers and evaluators only in cases where there is a possibility to develop a sound evaluation of that kind of impact.

For a student of behavioural additionality, the natural starting point to study the concept is its use in evaluation. This chapter, therefore, aims to provide a comprehensive account of the evaluation attempts of behavioural additionality. To do this, the chapter also studies the basics of the umbrella concept of additionality in Section 2.2. Section 2.3 discusses the evolution of the concept by looking at the three phases of behavioural additionality as a concept of evaluation; its origins, the OECD study and recent attempts to study the concept. A discussion on the commonalities and contradictions in the definition of the concept in different studies are utilised in Section 2.4. Finally, Section 2.5 concludes the chapter.

Throughout this chapter, there are a number of issues that are also relevant to policy-making. These points will be touched upon as necessary, but a more detailed discussion will be left to the next chapter.

2.2. Additionality Framework

The Oxford English Dictionary defines the word additionality as “the fact or quality of being additional” and “the principle of involving an additional component especially in financial deals” (Simpson and Weiner, 1989). The word has no significant daily connotation and is used purely technically. The areas where the term additionality is widely used in a technical manner are:

(i) additionality of the European Union Structural Fund,
(ii) additionality in the context of the Kyoto Protocol,
(iii) and finally additionality in the evaluation of public policy programmes.

This section will outline the major features of the above three uses of the additionality while putting the emphasis on the third one. The role of additionality in mainstream evaluation theories will also be touched on separately. Finally, attention will be given to the importance of additionality in the particular setting of technology and innovation policy evaluation.

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1 It has a considerable significance at the policy level, as will be discussed in the next chapter.
2.2.1. Additionality in the EU

The principle of additionality which asserts that “contributions from the Structural Funds will not replace public or equivalent structural expenditure by a Member State” has been in the core of the EU’s structural funds allocation for at least a couple of decades (European Council, 1999: Article 15.1; 2006: Article 11.1). Taking its logical basis from the principle of subsidiarity (which allows community action only in cases where individual members are insufficient), the principle of additionality mandates that EU funding should only be directed to those activities that the member states would not have done anyway so that the community resource creates ‘leverage effects’.

2.2.2. Additionality in the Context of the Kyoto Protocol

Another significant use of the concept of additionality is in the Clean Development Mechanism (CDM) of Kyoto Protocol. This protocol urges industrialised countries to decrease their carbon emissions to pre-1990 level by 2008-2012. To help this pursuit, the protocol defines three flexible mechanisms: ‘Clean Development Mechanism (CDM)’, ‘Joint Implementation (JI)’ and ‘Emission Trading (ET)’ (United Nations, 1998). CDM has a dual objective:

(i) assisting the sustained development of developing countries
(ii) and assisting the realisation of developed countries’ commitments and limitations in their emissions (Paulsson, 2009; United Nations, 1998).

CDM, in this regard, gives industrialised countries the opportunity to gain certified emission reductions by implementing projects that reduce emissions in non-industrialised countries. Therefore, industrialised countries, and firms from these countries in particular, reduce the cost of decreasing carbon emission by investing in more cost-effective projects in non-industrialised countries where the associated cost is significantly lower. Firms from industrial countries can only get carbon credits by funding projects in non-industrialised countries, which would not happen without their funding. This is called the principle of additionality in CDM. The principle of additionality, in this context, is evaluated by independent and licensed consulting companies by using a multi-phase, standardised, yet complex methodology. Their reports are subject to the final approval of a purpose-functioning UN body.

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2 The oldest reference to the principle of additionality in the Official Journal of the EU is dated 1979 and related to European Regional Development Fund, the predecessor of Structural Fund. A search in the historical archives of the European Parliament would reveal more history; however, it is not available to search it online unlike the Hansard in which a search dating back to 1803 is possible.
2.2.3. Additionality in Public Policy

Additionality is an important concept of evaluation of the programmes of mainstream public policies especially in the UK and some Commonwealth countries.

The source of this trend towards additionality in the UK originates from the above-discussed EU principle of additionality. A search for the word ‘additionality’ in Hansard reveals that the term has been in circulation since as early as the 1970s. In fact the oldest reference to the term is given by Mr. Russell Johnston, MP for Inverness, complaining about the imposition of a principle that is defined by the “horrible phrase [of] global additionality” (Johnston, 1975):

“The Commission thinks that there ought to be—to use its horrible phrase—global additionality. In simple English, it believes that the money should be regarded as an addition to already committed expenditure on regional development. [...] There are tremendous monitoring problems, but these could be overcome, particularly since we are continually telling everyone that our procedures are excellent and that problems faced on the Continent are hardly likely to trouble us.”

A Hansard search for the word further reveals that the concept has been an issue of contention and distaste until the late 1980s and early 1990s and it has mainly been used in relation to the EU’s additionality condition for the funds provided to the UK. However, since late 1980s, the term has entered into the domestic policy discussions and it has been used as a condition and measure of the success of domestic programmes. There are clusters of the concept being mentioned in Hansard in relation to the Lottery Fund, for instance, in various years before and after the particular Lottery Fund act was passed. Therefore, it is certainly possible to argue that while the EU’s principle of additionality was not always warmly welcomed in the political arena at the beginning, it has created an understanding and demand towards the use of the concept in domestic programmes.

Developments in the policy-making arena such as the popularity of evidence-based policy-making, Blair government’s predilection towards the use of evaluation, the foundation of organisations that promote evaluation within civil service like GSR and the National School, and Prescott’s Office of Deputy Prime Minister’s (ODPM) particular emphasis on evaluation have kept additionality in the agenda as well as the general framework of evaluation during the 1990s and 2000s in the UK.

It can be argued that the most explicit and extensive adoption of the concept of additionality is in Her Majesty’s Treasury’s so called Green Book which serves as a guide for economic evaluation
for public organisations. In this document, additionality is defined as the effect that the government creates with a policy less the case where there would have been no policy. The Green Book states that it “is [...] net, rather than [...] gross, impact after making allowances for what would have happened in the absence of the intervention”. In other words, additionality is what would have not happened had there been no intervention. Logically, it is also equal to what has happened minus what would have happened without an intervention. This effect can be in the outputs of the agents as well as in the ‘supply side’, e.g. inputs (HM Treasury, 2003: 52). Similarly, ODPM’s Guide on Spatial Interventions pursues the same definition (Office of the Deputy Prime Minister, 2003).

The main source for the methodology to measure additionality is the Additionality Guide commissioned by English Partnerships (English Partnerships, 2004, 2008). The same logic of additionality introduced in the Green Book and ODPM’s guide is followed in this document and in fact, the Green Book refers to this document’s second edition for further information as to how to evaluate additionality. Although the Guide approaches the concept of additionality from the angle of the housing/regeneration policy in particular, it provides examples from other policy areas, and is widely cited and accepted as relevant.

The Guide (and the Green Book and ODPM Guide) extends the definition of additionality and acknowledges that the following effects might be relevant:

- **Scale:** if the outputs or inputs would have been more or less
- **Timing:** if the outputs and inputs would have been sooner or later
- **Area or group:** if the outputs and inputs would have been in a specific area or group of agents
- **Quality:** If the quality of the outputs would have been different

This deserves further attention and will be discussed later in this chapter – the original point of behavioural additionality as it was coined was to a large extent covered in the above points.

The methodology introduced in the Green Book and ODPM Guide is detailed in the Additionality Guide. According to this methodology depicted in Exhibit 2, the first step of ‘calculating’ additionality is to form a ‘baseline scenario / reference case’ where there would have been no policy intervention to assess the effects that would have occurred anyway. This is also called the ‘deadweight’ of the policy intervention. The Additionality Guide recommends taking into consideration a wide range of contextual conditions to estimate the baseline. In most cases,

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3 Pearce and Martin (1996) report that the concept of additionality has been on the HM Treasury’s publications since as early as 1988.

estimating the baseline means estimating the ‘do minimum’ or nothing at all. However, in some cases, a baseline is an alternative intervention since

(i) Estimating the ‘do minimum’ case is simply not possible
(ii) or there would have been a change in the policy anyway.

After developing the baseline scenario, the next step is to subtract it from the ‘intervention options’, the case where the policy intervention is in effect. The difference is additionality.

There are four effects that need to be taken into consideration in the calculation of the above mentioned ‘policy options’ and reference cases / deadweights:

A. Gross Direct Effects: These are the directly observed and unadjusted effects such as total money spent or total outputs created.

B. Leakage from Target Group: This is defined as the “proportion of outputs that benefit those outside of the intervention’s target area or group” (English Partnerships, 2008: 17). In other words, the intervention can benefit agents other than the ones to which the intervention is directed and at the expense of them. This assumes that if the intervention benefits a non-target group actor, there would be no effect on policy goals. So for example, a policy intervention of providing grants to firms with the aim of increasing employment also benefits those firms that could or would not increase their employment at the expense of the firms those who could and would create extra employment, i.e. the target group, is leakage and should be adjusted accordingly.

C. Displacement and Substitution: These effects are considered together in the Green Book and defined as “the extent to which the benefits of a project are offset by reductions of output or employment elsewhere” (HM Treasury, 2003: 53). Displacement refers to the fact that while the intervention can create some effects in some specific actors, it can directly or indirectly decrease those effects in other parts of the system. For example, when the government supports the R&D efforts of some firms with the hope of increasing the total R&D spending, it might support particular firms that do not spend on R&D, thus making them more competitive which might decrease the R&D spending of the firms that conduct R&D on their own by making them less competitive (English Partnerships, 2008). At the extreme, displacement refers to crowding-out, i.e. increased government spending decreases the total spending.

The second effect in this category is called substitution, which refers to displacement of activities within an agent (English Partnerships, 2008; HM Treasury, 2003; Office of the Deputy Prime Minister, 2003). For instance, a firm that was awarded a grant might substitute its own R&D budget with public money.
D. **Multiplier Effects:** The final effect that needs to be taken into consideration in the estimation of both the policy options and the baseline / reference cases is the multiplier effects. It “measures the further economic activity, (whether output or jobs), resulting from the creation of additional local economic activity” (HM Treasury, 2003: 54).
Exhibit 2: The Green Book Method of Evaluating Additionality
It appears that the influence of this current penchant towards the concept of additionality in the UK has been significant in some of the Commonwealth countries as well. In Canada, it is called ‘incrementality’, and evaluated in R&D and Industrial Policy programmes (Lipsey and Carlaw, 1998a, 1998b; Lipsey et al., 2005; Usher, 1994). Similarly, Riding et al. (2007) report the tradition of evaluation of incrementality of loan guarantee schemes for SMEs in Canada.

2.2.4. Additionality and the Mainstream Evaluation Theories

Mainstream evaluation literature is a self-contained and well-established research area with widely used ‘textbooks’ and high impact specialist journals such as ‘American Journal of Economics’, ‘Evaluation and Program Planning’, ‘Evaluation Review’, ‘Educational Evaluation and Policy Analysis’, ‘Evaluation & the Health Professions’, ‘Measurement and Evaluation in Counselling and Development’, and ‘Zeitschrift fur Evaluation’. This literature often covers the scholarly work conducted in the fields allied to psychology and sociology such as educational policy, social policy and health policy, while it generally excludes the fields akin to economics such as economic policy, industrial policy and technology and innovation policy. In fact, in the mainstream evaluation literature, occasionally the term ‘social research/inquiry’ is used synonymously with evaluation.

Because of the economic policy relevance of the concept as will be discussed in the next chapter, additionality is implicit in the mainstream evaluation whereas it is explicitly taken into consideration in economics related fields. The logic of additionality is easily identifiable, however; the term is itself missing in the mainstream evaluation. In fact, the logic is so immanent in the mainstream literature that it does not need to be named explicitly – almost all evaluations cover additionality in some way or other.

Particularly in the so-called ‘impact evaluation’ branch of the mainstream evaluation, there are three broad categories of approaches to the design of evaluation that are implicitly in line with the logic of additionality (Alkin, 2004; McDavid and Hawthorn, 2006; Stufflebeam and Shinkfield, 2007; Wholey et al., 2004). These designs are presented below:

2.2.4.1. Experimental Designs

In experimental designs, the evaluator divides its sample into two groups on a truly random (i.e. experimental) basis so that these two groups are perfectly equal to each other. In that way, it is assumed to ensure that there is no inherent difference between these two groups. Then, the evaluator applies the intervention (or the so-called ‘treatment’) to one of the groups and the

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5 This point will be discussed more in depth in Chapter 3 in relation to the concept of additionality’s relevance to policy-making.
comparison between these two groups shows the exclusive impact of treatment. In other words, this kind of experimental design allows evaluator to isolate a casual relationship between the treatment and the outcome observation (Shadish et al., 2002).

Experimental designs are praised by scientist-like-methods-oriented-evaluation-theorists who deeply believe in positivism, and therefore, universal method in science. They argue that experimental designs as they are used in positive sciences, for example, are the only viable way to conduct research – they are the ‘gold standard’ (Alkin, 2004). Pharmaceutical research, for instance, is done exactly in the same way: dividing a sample randomly into two, administering the developed substance to the first group (treatment group) and the placebo to the second (control group). The observed difference between these two groups is causally attributed to the drug in question.

What is measured by experimental designs is ultimately additionality. The control group (which is inherently same as the treatment group because of random allocation) shows the counterfactual situation, i.e. what would have happened in the absence of the intervention. In other words, as Shadish et al. (2002: 6) put into words “two central tasks in experimental design are creating a high-quality but necessarily imperfect source of counterfactual inference and understanding how this source differs from treatment condition”.

There are mainly two types of experimental designs. The first and classical one is called Pre-Test Post-Test Design in which both the treatment and control groups are observed before the treatment and the measured difference between the post-treatment outcomes is adjusted against the difference in outcome before the treatment. The second type of experimental design is called Post-test only which is applied in situations where it is not possible to make an observation before the treatment. These two types are illustrated in Exhibit 3 in which R denotes random groups, O observations and X treatment.

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<th>Exhibit 3: Two Main Types of Experimental Designs6</th>
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<td><strong>Post-Test Only Design</strong></td>
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6 Taken from McDavid and Hawthorn (2006)
2.2.4.2. Quasi-Experimental Designs

Experimental designs are seen as the gold standard of evaluation (particularly impact evaluation). In the US, historically, educational programmes are required to be evaluated by using this approach by law (Rossi et al., 2004). However, in some cases it is simply impossible to conduct a truly randomised design for mainly four reasons. First, it may not be ethical to construct a group of agents applied an experimental intervention that may worse off their situation or at the other extreme; it may be unethical to forfeit a potentially beneficial intervention from a random group of individuals just for the sake of experimenting. Second, in some cases the sample size of agents that can be intervened might be so small that it may be impossible to form two random groups. Third, in some cases the cost of designing a random experiment can exceed the total cost of the programme. Finally, the threats to validity that will be discussed in the next sub-section can be so high that there would be no benefit to conduct such an evaluation (Whooley et al., 2004).

In those situations where it is not possible to pursue an experimental design, the next best choice is to approximate the conditions of the experimental design while at the same time to avoid the problems that undermine it. These types of approximations are called Quasi-Experimental Designs. There are four main types of Quasi-Experimental designs for which some examples are depicted in Exhibit 4. The first and most common is called single group Pre and Post Test Design, in which a group of agents is observed before and after a treatment and the difference between these observations is associated with the intervention. Here, there is no random element as there is only one group. The second type of quasi-experimental designs refers to two group designs, which depart from the above-discussed experimental two-group designs only by having two non-random thus non-identical groups. The evaluator in this case is expected to adjust for the biases stemming from not having randomly allocated groups. The third category is time-series designs, which might include the designs in the first and second category with observations in long-time intervals so that the evaluator can see the trend and adjust the causality accordingly. Finally, there are statistical matching techniques where two group designs are improved by trying to match the non-random treatment and control groups according to some characteristics perceived as significant for causal inference. Quasi-experimental designs are more prone to threats to validity in general and the evaluator’s duty is to minimise these.
Exhibit 4: Some Examples of Quasi-Experimental Designs

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2.2.4.3. Threats to Validity in Evaluation Designs

The logic of isolating the cause for the effect either by an experimental or a quasi-experimental design is prone to a set of so-called threats to validity that the evaluator needs to avoid or minimise in order to ensure that the inference is valid. There are mainly four broad categories of threats to validity (Rossi et al., 2004; Shadish et al., 2002; Stufflebeam and Shinkfield, 2007).

- **Threats to Statistical Conclusion Validity**: These are the threats to the validity of the statistical correlation between the treatment and outcome.
- **Threats to Internal Validity**: These relate to the causal relationship between the treatment and outcome.
- **Threats to Construct Validity**: These refer to the construct of sampling.
- **Threats to External Validity**: These are the threats to validity of the generalisability of the causal relationship between the cause and effect in a particular setting.

2.2.4.4. Non-Experimental Designs

There might be cases where experimental and quasi-experimental designs are simply not possible due to various reasons such as uniqueness of the units of analysis, high degree of threats to validity, ethical considerations and high cost. Furthermore, some evaluation scholars believe that even if experimental and quasi-experimental designs are practically possible, they are not appropriate for many situations (Alkin, 2004).

Scriven (1991) argues that experimental and quasi-experimental designs work with an hypothesis from the very beginning, which is not appropriate as an evaluation should be ‘goal-free’. Instead of these designs, he introduces a method called ‘modus operandi’ in which the evaluator reveals the characteristic causal chain connecting the cause with the effect. Eisner (1998) criticises the

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7 These validity problems will be discussed more in depth in Chapter 10 on the evaluation of behavioural additionality.
‘technological scientism’ of experimental and quasi-experimental designs by claiming that the quantitative nature of these approaches miss an important deal of issues that can only be captured qualitatively. Some other scholars believe that evaluation should be use-focused and meaningful recommendations cannot be provided by using these designs. Similarly, there are scholars claiming that the role of the evaluator is broader in terms of experience and personal judgement to be put into an evaluation than the narrow scientism of experimental and quasi-experimental designs (Alkin, 2004).

Non-experimental designs often focus on issues other than impact. Furthermore, in most cases, they are applied to formative evaluations contrary to experimental and quasi-experimental designs, which are used in summative evaluations and hence more often in impact evaluations. In those cases where non-experimental designs are used to evaluate the impacts, the common method is case studies. Additionality is an implicit issue here as well. Those kinds of non-experimental designs attempt to reveal the relationship between a particular cause and effect by studying a specific case. This ultimately requires (i) the comparison between the observed effects and counterfactual ones where there would have been no cause and then (ii) attribution of some or whole of the difference to the cause ultimately to form a causal relationship.

2.2.5. Additionality in Technology and Innovation Policy

Additionality has been an important concept of evaluation of technology and innovation policies and corresponding programmes for at least three reasons. Firstly, the above-discussed wider framework of evaluation of additionality has definitely contributed to the concept’s inception in the domain. Although the domain is distinct from other policy areas in terms of its nature, there is a certain level of linkage through which this kind of influence is expected. Secondly, as it will be discussed in depth in Chapter 4, the rationale for technology and innovation policy, whether it is neoclassical or evolutionary-structuralist, puts the concept of additionality as the hallmark of policies and programmes. Finally, the impact-measurement biased nature of the evaluation of technology and innovation policies and programmes makes the concept of additionality more popular along with other impact evaluation concepts.

Additionality appears in the technology and innovation policy evaluation literature in two broad categories. Firstly, the concept is spelled out explicitly in the studies conducted for the EU programmes or EU member state national programmes. In particular, British programmes dominate the second group. Secondly, there are a number of studies, particularly from the US, that do not mention additionality explicitly but includes the logic and methodology inherently. For instance, summarising the previous evaluations of ATP, one of the most important and
Part I Chapter 2: Behavioural Additionality as a Concept of Innovation Policy Evaluation Literature

densely evaluated US publicly supported technology programmes, Ruegg and Feller (2003: 160) report that

“For ATP, a question of central importance is what difference ATP makes for the projects it funds. Or, expressed counterfactually, what would have happened had there been no ATP. These questions are fundamental to both the politics and economics of the program.”

Additionality is generally considered in three horizontal types in technology and innovation policy and evaluation literature: input, output and behavioural additionality. The first two will be discussed here whereas the next section will be devoted to the third.

Input additionality refers to the evaluation question if the policy intervention increased the inputs devoted to technology and innovation. Inputs in this context are mainly financial inputs, i.e. the financial investment. Input additionality has been one of the most popular impact evaluation approaches and definitely the most evaluated additionality type historically. There are a vast number of scholarly studies on input additionality. Historically, the concept of input additionality has been implicit in the literature – the word additionality has not been used but the logic was there. However, in recent years it appears in not only the scholarly articles published in the journals in technology and innovation domain (i.e. Research Policy, Research Evaluation, Technovation, etc.) but also those published outside of the domain and even the mainstream economics journals (see Gorg and Strobl (2007), for example) that use the term ‘additionality’ explicitly.

The extensive literature review by David et al. (2000) potently summarises the literature in the 1980s and 1990s. The issue is approached from the very angle of economics by asking the question if public R&D expenditures (including grants for business R&D) are complementary or substitute for private R&D expenditures. In other words, the review takes stock of the studies by inquiring if public R&D expenditures increase private R&D expenditures (additional to them) or decrease private R&D investment (displace or crowd out them). This is clearly additionality as it is ultimately asking if the private R&D would have been higher or not with increased level of public R&D. David et al. (2000) review reveals that there were at least 33 studies up to 2000 in different levels of analysis such as intra-firm, firm, industry and aggregate based on US and non-US data. Of the 19 studies on the firm level or below (micro level studies), almost half of them revealed substitution (no or negative additionality), while only one-seventh of industry level or above studies (macro level studies) reached that conclusion.

Historically, input additionality studies use time series survey data and employ sophisticated econometric analysis to attribute the change in the trend to policy action although there have
been a number of studies that use panel data on control groups. It is observed that the latter design is on the rise in recent years.

Input additionality studies, especially the scholarly literature on mainstream economics journals has had a tendency to ignore systemic effects such as displacement, spillovers and skewed distributions and in some cases even multiplier effects. However, a recent emphasis on those points in the evaluation of input additionality is observed (Klette et al., 2000).

Bach and Matt (2005: 34) criticise the approach of input additionality by claiming that there are some certain assumptions “more or less explicitly” taken, such as “the clear link between input and output in innovation activities”, the existence of “divisibility and constant return[s] to scale in them” and “same nature of the output generated by the public funds and private funds”.

Output additionality refers to the question whether the outputs would have been the case without a particular public intervention. Here, output can be anything including patents, publications, turnover, exports, new products, etc. Output additionality has also been a popular topic in evaluation especially for those looking at economic impact. As with input additionality, the primary method is using econometric analysis based on either aggregate time-series data or micro-level panel data. However, unlike inputs that are investments in most of the cases, outputs would need to be converted into monetary values, as they are mostly non-monetary. The methods and approaches to do this have always been seen as a challenge and potential issue of debate in the literature. One final interesting difference between input and output additionality is that, although in a sizeable number of input additionality studies the term ‘additionality’ is explicit; it is used implicitly in output additionality studies.

Bach and Matt (2005) argue that besides its physical and simplistic characteristics, output additionality is not associated with the use or impact of the output created, drawing an incomplete framework with the very output itself. They also argue that output additionality ignores the process of output creation and there can be some other outputs created beyond the policy objective, which are not appraisable within this approach.

Finally, there is a third and final kind of additionality called behavioural additionality, which is the very topic of this thesis. Briefly, it refers to the question of whether the policy action changes the persistent behaviour of agents in such a way that would not have happened without the policy action. The concept of behavioural additionality will be analysed in depth in the next section.

2.3. Evolution of the Concept of Behavioural Additionality

The concept of behavioural additionality (BA) has undergone three phases in its lifetime. First came the original idea in 1995 and it was followed by some studies in early 2000s. These
attempts constitute the initial conceptual development. In the second phase, the OECD studies contributed to the operationalisation of the concept as well its further conceptualisation. Finally, there have been a number of recent attempts to operationalise the concept by scholarly publications. These three phases illustrated in Exhibit 5 will be discussed in this section in a chronological order.

2.3.1. Origins of Behavioural Additionality

To summarise the evolution of behavioural additionality as an evaluation concept, the starting point should be the study of Buisseret et al. (1995). Stressing the importance of additionality, they favour the use of input and output additionality and then propose a third kind of additionality to measure in between these two: behavioural additionality. By emphasising agents’ “detailed exploitation’ routes by which research results may be transferred to their commercial activities”, they (1995:589-590) define behavioural additionality as “the change in company’s way of undertaking R&D which can be attributed to policy actions”. Furthermore, they use the example of collaboration to explain the concept. They argue that the collaborative behaviour of the firms attributable to the public support is behavioural additionality.

The concept of behavioural additionality at the beginning was very simple and linear process that takes input, processes it and creates the output. Furthermore, there was no stress on persistency. Yet this approach was groundbreaking for its time. It represented the innovative approach to evaluation that has its roots in the wave compelled by Nelson and Winter (1982) some years before that paper.

Three years after conceptualization of behavioural additionality, Davenport et al. (1998) applied the concept to the Australian Technology for Business Growth (TBG) Programme’s evaluation. Confusingly enough they discuss project additionality as a fourth kind and they use the same definition that Buisseret et al. (1995) made for behavioural additionality. They (1998:65) propose to isolate “part of programme which is promoting the behavioural change”. Although that paper does not represent an intellectual progress over the concept, it is a valuable addition to the literature focusing on behavioural additionality to form the critical mass.

After its brief appearance as a pitfall of cost-benefit analysis in evaluation in Fahrenkrog et al. (2002), Bach and Matt (2002) in Georghiou et al. (2002) used behavioural additionality extensively8. The latter paper is the earlier version of Bach and Matt (2005) which will be discussed in the next chapter on policy-making.

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8 Although it is explicitly stated that one of the chapters had been written by Bach and Matt in the cover of Georghiou et al. (2002), there is no indication about the authors for the relevant chapter referred here.
However, because the paper is obviously an earlier version of Bach and Matt (2005), it is assumed that it was written by Bach and Matt.
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The real contribution to the development of the concept was made by the first large-scale application of behavioural additionality to evaluation of public support. IWT-Flanders, the public organisation responsible for funding the private research in the Flanders region of Belgium organised a conference on 'Innovation Policy and Sustainable Development. Can public incentives make a difference?' that was held in Brussels, in February 2002. One of the topics covered in that conference was behavioural additionality through the paper by Georghiou (2002a, 2002b). After that conference, IWT-Flanders decided to undertake a pilot study on the behavioural additionality of its support. Furthermore, they devoted the 48th issue of IWT-Studies to that topic (Clarysse et al., 2004; Georghiou, 2004; Larosse, 2004).

The first paper in that issue by Georghiou (2004) is the first published attempt to define behavioural additionality in a more analytical and systemic way. Georghiou (2004:7) defines the concept as “the difference in firm behaviour resulting from the intervention”. This definition represents a very different perception from that of Buisseret et al. (1995). The former paper represents a stress on the change in the process of conducting R&D as Bach and Matt (2005) criticise. However, the definition in Georghiou (2002a) represents a broader and persistent change in all sorts of behaviour of the firm. Indeed, Georghiou (2002a) underlines the persistency feature he added to the concept, pointing out that input and output additionality “operate at a point in time, behavioural additionality effects may be expected to endure beyond the period of R&D and to be integrated into the general capabilities of the firm”. Furthermore, he classifies the proposed fourth kind of additionality, the so-called cognitive capacity additionality, as a dimension of behavioural additionality.

Georghiou (2004) attempts to identify the possible dimensions that the policy can affect as ‘knowledge acquisition’, ‘human resources’, ‘capital investment’, ‘market position’, ‘manufacturing or service provision’ and ‘corporate responsibility and sustainability’. Furthermore, he matches these with the policy measures he categorised. Finally, he develops a sample questionnaire to evaluate behavioural additionality.

Similarly, Clarysse et al. (2004) develops a pilot study (which was going to be the basis of the Belgian study in the OECD project) by using the very same framework that Georghiou (2004) developed.

Finally, Larose’s (2004) paper is the last one in the IWT-Studies special issue on behavioural additionality. Although his paper does not include a reference or bibliography section, his analysis relies on Bach and Matt (2002) and Lipsey and Carlaw (1998b). He distinguishes the framework that forms the basis for input additionality from the framework for behavioural additionality intuitively (by not calling ‘neo-classical’ and ‘evolutionary’). Therefore, as will be discussed in Chapter 4, I will only refer to Table 1 to summarise Larose’s (2004) position.
Table 1: Larose’s (2004) Comparison of the Three Types of Additionality

<table>
<thead>
<tr>
<th>Traditional Additionality</th>
<th>Behavioural Additionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear innovation model: Input additionality as proxy for</td>
<td>Non-linear innovation model: Interactivity is key to innovation performance</td>
</tr>
<tr>
<td>ultimate innovation outcome</td>
<td></td>
</tr>
<tr>
<td>Behaviour of applicants as ‘black-box’</td>
<td>Behaviour of applicants is central</td>
</tr>
<tr>
<td>Allocation behaviour as sufficient theoretical foundation</td>
<td>Different kinds of behaviour (markets, hierarchies, networks) in innovation system need</td>
</tr>
<tr>
<td></td>
<td>broader conceptual approach</td>
</tr>
<tr>
<td>Market failure as rationale</td>
<td>System failure as rationale</td>
</tr>
<tr>
<td>‘Optimality’ of allocations as reference</td>
<td>‘Real world’ as reference</td>
</tr>
<tr>
<td>Focus on the evaluation of the impact on the firm</td>
<td>Shift to evaluation of spill-overs to the system</td>
</tr>
<tr>
<td>Evaluation of single instruments</td>
<td>Evaluation of complementary instruments (leverage)</td>
</tr>
<tr>
<td>Impact assessment is main challenge (attrition problems)</td>
<td>Policy learning is main challenge (improving policy design)</td>
</tr>
<tr>
<td>Problem of counterfactual analysis (finding identical control</td>
<td>Problem of comparative analysis (similar situations, never alike)</td>
</tr>
<tr>
<td>groups)</td>
<td></td>
</tr>
<tr>
<td>Money transfer is central: Redistributive function of</td>
<td>Interaction is central: Catalyser role of government</td>
</tr>
<tr>
<td>government</td>
<td></td>
</tr>
<tr>
<td>Additionality versus ‘crowding out’ = negative connotation</td>
<td>Additionality as ‘value-added = positive connotation</td>
</tr>
</tbody>
</table>

2.3.2. The OECD Study

After the IWT pilot study, the fuelling contribution to behavioural additionality came from the OECD project. As explained in OECD (2003:2), “Following a proposal made at the December 2002 meeting of the TIP Working Party, the IWT (Flanders) and OECD organized a one-day working meeting in Brussels on Tuesday, February 4, 2003 to discuss future activities to evaluate the effects — and effectiveness — of government policies for stimulating business R&D.” In this meeting, OECD (2003:2) reports that “TIP delegates suggested that future work attempt to investigate how governments can improve the effectiveness of individual instruments and the mix of policies used to support business R&D and innovation.”

To this aim, the concept of behavioural additionality was considered as important and OECD TIP members agreed to undertake a pilot project on the evaluation of behavioural additionality. Among the countries that declared interest on this issue was Australia, Austria, Belgium, Finland, Germany, Japan, Korea, Norway, United Kingdom, United States and the EU and a workgroup was formed.

After the kick-off, this workgroup concentrated their efforts developing a methodology to evaluate the behavioural additionality effects of their respective supports and compare the preliminary findings. The workgroup had two formal meetings during the project lifespan.

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9 Taken from Larose (2004).
first workshop co-organised by the OECD and PREST took place in Manchester on 10-11 May 2004. After the conceptual debates following this meeting, the workgroup gathered again in Vienna on 31 January -1 February 2005.

During the project lifetime marked by these workshops, the participating countries first attempted to develop a conceptual framework of behavioural additionality. This phase was overseen by Prof Luke Georghiou as the originator of the concept and the developer of the majority of the relevant literature.

Building on that, each participating country attempted to develop a specific evaluation framework within the objectives of the project and implemented pilot studies. Following these evaluations, the results were compared across the workgroup. Finalising the project, OECD (2006a) published a book consisting of an introduction and synthesis chapter written by Luke Georghiou and Bart Clarysse and 12 following chapters for each evaluation effort. Before discussing the 12 individual studies for the evaluation of behavioural additionality, I will discuss the first chapter of the OECD (2006a) which is one of the most recent and comprehensive conceptualisations of behavioural additionality.

Defining the concept up to that date intuitively to some extent, Georghiou and Clarysse (2006) attempt to provide behavioural additionality with a conceptual background. To do this, they employ the concepts of strategic management literature such as ‘resource-based view’ and ‘value innovation perspective’.

Regarding the use of resource based view to explain the behavioural additionality, Georghiou and Clarysse (2006) cite Barney (2001), who exposes the resource-based view arguing that among the resources firms possess, a subset of them provides the firms with a competitive advantage. Still another subset of those leads to superior long-term performance. Competitive advantage can be created with the use of the resources that are valuable and rare. As long as the firm protects these resources from imitation, transfer and substitution, the competitive advantage endures.

The resource-based view asserts that the intangible resources are mainly the determinants of performance heterogeneity among firms and thus are the likely sources of competitive advantage. The resources that this view focuses on may be the tangible ones such as capital and labour, as well as intangible resources such as technological knowledge and competencies.

Georghiou and Clarysse (2006: 13) employ the view in their discussion of behavioural additionality. They argue that an R&D funding creating additionality “should allow an increase in the company’s resources in such a way that it results in a competitive advantage”. Furthermore, they exemplify this by arguing that “enabling a company to attract a unique skill which it would
otherwise not be able to recruit or access may be more important than recruiting five relatively easy-to-find engineers because of funding provided by an R&D grant”, referring to the core of the behavioural additionality.

Carrying the argument further, Georghiou and Clarysse (2006) employ the dynamic capabilities model, as a complement to the resource based view. They report that the dynamic capabilities model is defined by Teece (Georghiou and Clarysse, 2006; Teece et al., 1997) as the ability to integrate, build, and reconfigure internal and external competencies to address rapidly-changing environments. In Georghiou and Clarysse’s (2006:13) words, it refers to “the firm’s ability to assemble, integrate and deploy valued resources to accomplish its target”. Furthermore, it is argued that these dynamic capabilities are the main source of the innovation itself.

Similarly, both Georghiou and Clarysse (2006) and Clarysse et al. (2006) employ Wheelwright and Clark’s (1992) innovation funnel concept. Wheelwright and Clark (1992) argue that there exists an innovation funnel for which “each development of a new product is managed through milestones on which ‘go/no-go’ decisions have to be made by a certain committee based on a write-out or a presentation of progress” (Clarysse et al., 2006:102).

Georghiou and Clarysse (2006:14) argue that the key success factors of the resource-based view such as heavyweight team managers, cross-functional teams, team tenure and the use of partnerships “are optimised along the innovation funnel”. They argue that behavioural additionality is the change in decisions in these gates.

As a second effort, Georghiou and Clarysse (2006) attempt to employ value innovation to form a basis for the theoretical foundation of the concept of behavioural additionality. They argue that the value innovation, i.e. strategies to pursue new markets and/or build up new competencies that can result in an entirely new business, is the source of quantum leap of the firms. Georghiou and Clarysse (2006:14) cite some scholars claiming that “most companies that are among the top in their industry did not obtain this position through outperforming the others, but because they had entered a new market segment that tended to be a growing one”.

Furthermore, Georghiou and Clarysse (2006:14) claim that unlike the resource-based view theory, “value innovation points to the long-term need to change an industry or industry segment regularly”. Therefore, a support can create behavioural additionality by “changing a firm’s strategy and encouraging it to enter a new market”.

Apart from these conceptual discussions, Georghiou and Clarysse (2006) make another important contribution to the concept of behavioural additionality. As part of the second goal of their chapter in OECD (2006a), they summarise the 12 studies that were conducted in the OECD project. To do this, they develop a methodology to explain the layers of behavioural
additionality. Although it is not extensively discussed, they categorise the behavioural changes as ‘during the project implementation’ and ‘after the project implementation’. Then, they propose seven layers of behavioural additionality. These layers are summarised below:

**Behavioural changes during project implementation:**

- **Project Additionality** (Decisions regarding project launch): This layer of additionality is related to the decision of launching the project that would not be the case in the absence of the support. Furthermore, this layer is a facet of input additionality.

- **Acceleration Additionality** (Acceleration of projects): Acceleration additionality refers to the increase in the pace of the project that would not be the case in the absence of the support. In other words, it investigates whether the supports lead to a faster project completion or not.

- **Scope and Scale Additionality** (Expanded scale and scope): Scope and scale additionality refer to the extent of scope and scale of the project that would not be the case in the absence of the support. It is closely linked to the input additionality as well.

- **Challenge Additionality** (More challenging research): This layer of additionality raises the question of whether the support enabled the firm to conduct a more challenging project that would not have been undertaken in the absence of the public funding.

**Behavioural changes after project completion:**

- **Network Additionality** (More collaboration): Network additionality refers to the collaboration that the public funding created. It asks the question whether the project would be conducted in a less collaborative way in the absence of the supports. It also covers the persistence of this collaboration effort after the completion of the project.

- **Follow-Up Additionality** (Project follow-up): Follow-up additionality is related to the spin-off projects that are created by the funded project and that would not have been the case in the absence of the support. It is particularly important from the aspect of sustainability.

- **Management Additionality** (Improved management): It is related to the management routines that the firm adopted because of the public funding. “These changes could result in further participation in government programmes, changes in organisational structures for conducting R&D or commercialising results, and different management strategies” (Georghiou and Clarysse, 2006:31).

Moving to the studies conducted in relation with to OECD project, the workgroup members, the programmes addressed and the methodology they used are summarised in Table 2 taken from Georghiou and Clarysse (2006). The respective studies are conducted by Australia, Austria (two separate programmes evaluated – FFF and Kplus), Belgium, Finland, Germany, Japan, Korea,
Norway, United Kingdom, United States and the EU. The scope of their studies and the methodologies employed are summarised below, followed by a summary of their findings, which are depicted in Table 4 and Table 5.

<table>
<thead>
<tr>
<th>Country</th>
<th>Programme</th>
<th>Methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>R&amp;D Start Programme</td>
<td>100 firms interviewed by telephone or in-person</td>
</tr>
<tr>
<td>Austria</td>
<td>Austrian Federal R&amp;D Support Scheme (FFF)</td>
<td>Compares survey responses about hypothetical scenarios (1 000 firms) to actual consequences documented in administrative records (420 firms)</td>
</tr>
<tr>
<td></td>
<td>Kplus Funding Initiative</td>
<td>Compares questionnaire-based survey of 118 firms (75% of those surveyed) with responses to the 3rd Community Innovation Survey</td>
</tr>
<tr>
<td>Belgium</td>
<td>IWT Support Programme</td>
<td>Telephone interviews plus additional in-take interviews for large R&amp;D-intensive firms</td>
</tr>
<tr>
<td>Finland</td>
<td>Tekes Funding Programme</td>
<td>Questionnaire-based survey (193 respondents)</td>
</tr>
<tr>
<td>Germany</td>
<td>Public R&amp;D Project Funding</td>
<td>Data from CIS Germany: 659 firms were surveyed by telephone interview; 203 responded (39% response rate)</td>
</tr>
<tr>
<td>Japan</td>
<td>R&amp;D Projects of NEDO</td>
<td>Interviews and questionnaires (501 firms and other institutions responded)</td>
</tr>
<tr>
<td>Korea</td>
<td>General R&amp;D Funding</td>
<td>Econometric analysis based on public and private sector R&amp;D data</td>
</tr>
<tr>
<td>Norway</td>
<td>Loans and Grants from Innovation Norway</td>
<td>Interviews (807 firms responded. 67% response rate)</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>SMART and LINK Initiatives</td>
<td>10 in-depth case studies of firms looking at grant histories</td>
</tr>
<tr>
<td>United States</td>
<td>Advanced Technology Program</td>
<td>Online survey with follow-up by telephone interview (81% response rate)</td>
</tr>
<tr>
<td>European Union</td>
<td>5th Framework Programme for Research and Technology Development (FPS)</td>
<td>Questionnaire survey: 1 700 responses. Also survey to rejected applicants.</td>
</tr>
</tbody>
</table>

**Australia R&D Start Programme**

The Australian R&D Start Programme comprises both competitive grants programmes and an entitlement-based R&D tax concession “aimed to improve industry competitiveness, enhance productivity and ensure the introduction of innovative new products, processes and services to the market”. “The R&D Start programme was established in 1996 and closed in September 2004. During this period, it provided USD 1.01 billion in grants to 1,134 companies” (Department of Industry Tourism and Resources of Australia, 2006:39).

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The study interpreted behavioural additionality as “persistent changes in firm attitude, culture or behaviour that resulted from participation in a grant process” (Department of Industry Tourism and Resources of Australia, 2006:39). To this aim, they argue that “a survey approach that combines quantitative and qualitative aspects to enable changes to be measured and to investigate the reasons for these changes” is deemed necessary (Department of Industry Tourism and Resources of Australia, 2006:41).

The survey is implemented in face-to-face or telephone interviews with senior executives from a sample of 100 firms representing 9% of the total programme population.

The Australian study (Department of Industry Tourism and Resources of Australia, 2006) used a short survey to measure the effects of government grants by asking firms whether they would have a project and if they had, whether it would be:

- with a smaller budget,
- more slowly,
- with less external collaboration,
- with less ambitious outcomes and
- with a smaller range of potential applications in the absence of the support on a 5 point Likert scale.

Moreover, “the subsequent group of questions sought to determine the degree of behavioural additionality at firm level induced by the grants, focusing on cultural attitudes, project and business management, and the development of external collaborative relationships” (Department of Industry Tourism and Resources of Australia, 2006:42).

**Austrian Federal R&D-Support Scheme (FFF)**

Falk (2006) reports that the behavioural additionality of the Austrian Federal R&D-Support Scheme (FFF) measured through the existing survey conducted in 2003 to understand the customer’s appraisal of the working of the FFF. According to Falk (2006:60), this survey includes the questions geared to the following two groups of firms:

- “successful applications that received funding from the FFF and who were asked hypothetical questions about what would have happened if they had not received FFF funding; and
- failed applications who did not receive FFF funding and were asked questions about what actually happened to their proposed projects.”

This kind of a structure enabled the evaluators to compare these two groups by “detecting biases in the answers of successful firms (which might answer the questionnaire strategically to highlight the importance of the FFF funds)” (Falk, 2006:62).
The study, by comparing these two groups, therefore, aims to explore project additionality, scale additionality and scope additionality in terms of collaboration and research topics. This analysis relies on a descriptive statistics (Falk, 2006).

**Austrian Kplus Funding Initiative**

The third evaluation attempt in relation to the OECD-TIP project is Austria’s Kplus programme. In Georghiou and Clarysse’s (2006:23) words, Kplus competence centres “are platforms for science-industry co-operation that focus on changing research culture by using public funding to help bring together researchers from the public and private sectors”. Firms and universities form a Kplus centre, along with a legal firm to conduct R&D projects, where up to 60% of its total costs are funded by the programme during a maximum of 7 years.

The evaluation for behavioural additionality is reported by Steyer (2006) through a survey conducted with 158 partnering firms affiliated to the 12 Kplus competence centres.

Georghiou and Clarysse (2006:23) describe the methodology employed by the evaluator as “before-and after-methodology: participating firms were asked to give information on the situation before the Kplus centre had started and on the situation four years later”. In addition, they used EU’s Community Innovation Survey (CIS) results to compare the findings.

**Belgium IWT Support Programme**

The Belgium study tries to measure the behavioural additionality effects of the IWT-Flanders’ R&D support programme, the main support for the Flanders region of Belgium (Clarysse et al., 2006).

Clarysse et al. (2006:63) criticise the assumption made by econometric studies on the firm size. They argue that in practice there should be “a clear distinction between different groups of companies in terms of their type”. Therefore, they categorise the firms into these 4 distinct groups to measure the behavioural additionality:

- Large R&D-based firms (Group I)
- Large non-R&D based firms (Group II)
- SMEs without permanent R&D (Group III)
- High-tech R&D (Group IV)
The Belgium study then conducted an interview with the large R&D based firms “to better understand their innovation processes, decision processes for R&D projects, and management of government grants. These talks were seen as an essential part of the interview process and helped better target questions to the different respondents within each firm” (Georghiou and Clarysse, 2006:24).

After this interview, the pilot study designed a modular survey consisting of different parts peculiar to different firms. This survey was then performed via telephone interviews to a small number of firms within each category. This structure of the questionnaire is summarised in Table 3.

**Finland Tekes Funding Programme**

Tekes, the national body responsible for the R&D supports to the Finnish industry, is the subject of the Finnish study. The study itself does not bring a new evaluation effort but in Georghiou and Clarysse’s (2006:24) words draws “on a number of previous studies that used a combination of interviews and surveys”.

After introducing a series of evaluation studies funded by Tekes on input additionality and other effects, the Finnish study (Hyvärinen, 2006) summarises a research conducted by Pekkanen et al. (2004). The study reported by Hyvärinen (2006:119) aimed “to evaluate business manager’s attitudes about the additional effects of Tekes R&D funding”. He explains that out of the random

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**Table 3: Belgium Study Questionnaire Structure**

<table>
<thead>
<tr>
<th>Modules</th>
<th>No permanent R&amp;D activities</th>
<th>Permanent R&amp;D activities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SMEs</td>
<td>Large</td>
</tr>
<tr>
<td>Group</td>
<td>III</td>
<td>II</td>
</tr>
<tr>
<td>1. General information about the firm</td>
<td>=</td>
<td>=</td>
</tr>
<tr>
<td>2. Competitive market position</td>
<td>=</td>
<td>=</td>
</tr>
<tr>
<td>3. R&amp;D budget, grants and personnel</td>
<td>=</td>
<td>=</td>
</tr>
<tr>
<td>4. Description of the project</td>
<td>=</td>
<td>=</td>
</tr>
<tr>
<td>5. Project development process and organisation</td>
<td>=</td>
<td>=</td>
</tr>
<tr>
<td>6. Project output, results and impact</td>
<td>=</td>
<td>=</td>
</tr>
</tbody>
</table>

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11 Source: Clarysse et al. (2006:63)  
12 The equal sign means that the corresponding part is same for all groups.
sample of 1,000 manufacturing and services firms from a database of Statistics Finland, a questionnaire that is designed on a Likert scale was sent to managers of 645 firms in order to get information about their perceptions of the impact of public R&D funding.

Germany Public R&D Project Funding

Georghiou and Clarysse (2006:25) report that “the German study that is based both on results of the German Community Innovation Survey data from 2000 and 2003 (659 firms) and a telephone survey of firms that received public R&D funding for projects that were completed between July 2002 and August 2004 evaluates the behavioural additionality effects of public R&D funding provided via direct project grants from the federal government”. With this data, then, Fier et al. (2006) undertake a descriptive analysis and an accompanying multivariate econometric analysis.

The study mainly relies on the collaboration aspect of the behavioural additionality and tests these two hypotheses (Fier et al., 2006: 132):

- “public R&D funding stimulates firms to seek new R&D partners, i.e. different from the partners they usually co-operate with.”
- “business or science collaborations newly initiated within a publicly funded R&D project are lasting.”

Japan R&D Projects of NEDO

The Japanese study undertaken by Suzuki and Yumitori (2006) follows to the Finnish study in a similar way. They attempt to review two studies already conducted to explore the behavioural additionality and contribute to the project.

The first study reported at Suzuki and Yumitori (2006) is the Japanese New Energy and Industrial Technology Development Organization’s (NEDO) follow-up monitoring activity. They compare the before, during and after the project phases of the monitoring survey filled in by 501 entities from 56 R&D projects between 2001 and 2002. This survey consists of 90 questions from the main parts such as details of business, utilisation of intellectual property, spill-over effects and NEDO’s management.

The second source of data is Sakakibara’s survey on NEDO projects which in Georghiou and Clarysse’s (2006:26) words “aimed at collecting data related to participation in national programmes and focused on several topics, such as objectives of participation, indirect effects of the programmes and the degree of networking and co-operation with other organisations”.

Suzuki and Yumitori (2006) reveal that this study is not fully appropriate to understand the behavioural additionality of the NEDO programme, as it does not isolate the effect of the intervention but rather compares the situation before and after the funding. Their analysis is also
deemed to deliver poor results as they advise the government to build behavioural additionality methodologies and promote the adoption of such practices.

Korea General R&D Funding
The Korean study conducted by Shin (2006) is not an evaluation attempt for behavioural additionality but rather an attempt to derive input additionality by employing econometric analysis on a simple investment function with aggregate data. The study employs a time-lag to the model and attempts to measure the time-lag effect of public funding of R&D on private funding of R&D. This lag effect is then labelled as behavioural additionality.

Norway Loans/Grants From Innovation Norway
The Norwegian study conducted by Madsen and Brastad (2006: 182) of Nordland Research Institute examines the supports given by Innovation Norway (IN), Norway’s institution for industrial R&D support, in 2000. The study attempts to answer the questions: “how does IN contribute to the realisation of projects?” and “how does IN's involvement affect important objectives and processes of change in a company?”

For this purpose, the study analyses a preliminary survey conducted just after the support, in 2001. Madsen and Brastad (2006) then report that they conducted an interview from January to March 2004 with the firms that still operate after they responded to this survey. From this data set, then, the Norwegian study tries to derive implications by employing econometrics.

UK SMART and LINK Initiatives
The UK study conducted by Malik, Geoerghiou and Cameron investigates the behavioural additionality effects of two R&D support programmes, LINK and SMART by interviewing the senior managers of 10 firms selected from the support database.

The evaluators (Malik et al., 2006: 210) underline three strategic questions used in these interviews as:

- “Whether the support helps to overcome a lock-in failure by introducing a firm to a new or extended technology or market area?”
- “Whether the support is building new networks or co-ordinating systematic innovations such as those requiring establishment of standards, either between firms or between firms and the research base?”
- “Whether the support has provided the firm with incentives to acquire new competencies, ranging from project management skills, through various acquired technological and market capabilities, and possibly encompassing innovation and
commercialisation capabilities (for example securing intellectual property or raising venture capital investment)?”

To this aim, it is reported by Malik et al. (2006: 211) that an interview guide designed “focus on the areas of the firm’s strategy and formulation process, its current strategy profile, experience of public supported R&D initiatives, details about the SMART or LINK project and additionality effect” and tested on a small local firm.

US Advanced Technology Programme

The study representing the United States of America investigates US Department of Commerce National Institute of Standards and Technology sponsored Advanced Technology Programme (ATP). Georghiou and Clarysse (2006) report that the main aim of the study was to assess the programme’s success in forming joint R&D ventures.

ATP, signed a contract with Westat, a private research firm specialized at survey design to measure this. Shipp et al. (2006: 222) report that Westat developed the survey with two versions, one for companies and one for non-profit organisations. This survey was then conducted via the Internet and “for those that did not respond to the online survey a follow-up phone interview phase (was) undertaken”.

With this data, the study undertakes an econometric analysis where the ATP effect is the dependent variable in forming joint ventures.

EU 5th Framework Programme for Research and Technology Development (FP5)

The final study performed in relation with OECD-TIP workgroup on behavioural additionality attempts to identify the behavioural additionality effects of the European Union’s 5th Framework Programme (FP5). Georghiou and Clarysse (2006) report that Polt and Psarra (2006) re-examine the results of the Five-Year Assessment of FP5, a large study conducted by a wide range of evaluators and included a survey distributed to 12,000 participants of FPS during 2004.

Within this data set, the authors conduct a descriptive analysis on behavioural additionality elements. One noteworthy point about this study is its reference to the concept of negative additionality of which Georghiou and Clarysse (2006) underscore the importance.
<table>
<thead>
<tr>
<th>Country</th>
<th>Project Additionality (Project launch)</th>
<th>Acceleration Additionality (Accelerated schedule)</th>
<th>Scale and Scope Additionality (Expanded scale &amp; scope)</th>
<th>Challenge Additionality (More challenging research)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>37% would have cancelled.</td>
<td>100% would have taken longer.</td>
<td>92% would have scaled down.</td>
<td>78% would have been less challenging. 64% would have reduced range of applications.</td>
</tr>
<tr>
<td>Austria (FFF)</td>
<td>28% would have cancelled (31% did cancel). 61% would have sought alternative funds (25% did seek alternative funds).</td>
<td>32% would have postponed (43% did postpone). 51% would have taken longer (61% did take longer).</td>
<td>74% would have scaled down (60% did scale down).</td>
<td>49% would have been less challenging (40% were less challenging).</td>
</tr>
<tr>
<td>Austria (Kplus)</td>
<td>33% would have cancelled.</td>
<td>Firms would have slowed down the implementation.</td>
<td>67% would have carried out project with limitations.</td>
<td>Firms would have reduced the technical challenge.</td>
</tr>
<tr>
<td>Finland</td>
<td>20% would have cancelled.</td>
<td>—</td>
<td>46% would have scaled down.</td>
<td>48% of projects were too risky to carry out alone. 73% would have reduced technical ambition.</td>
</tr>
<tr>
<td>Germany</td>
<td>—</td>
<td>With government funding, 53% sped up project launch; 28% sped up project implementation.</td>
<td>With government funding, 55% extended project size.</td>
<td>With government funding, 60% pursued more technically challenging projects.</td>
</tr>
<tr>
<td>Norway</td>
<td>53% would have cancelled.</td>
<td>16% would have slowed the R&amp;D.</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>United States</td>
<td>93% would have cancelled.</td>
<td>—</td>
<td>—</td>
<td>82% of funded projects were more ambitious than firms’ typical R&amp;D projects, and 70% were more technically challenging.</td>
</tr>
<tr>
<td>EU</td>
<td>57% would have cancelled.</td>
<td>33% would have taken longer.</td>
<td>76% would have scaled down.</td>
<td>43% would have been less challenging.</td>
</tr>
</tbody>
</table>

Source: Taken from Georghiou and Clarysse (2006)
## Table 5: Behavioural Additionality After The Project: Summary and Findings\(^\text{14}\)

<table>
<thead>
<tr>
<th>Country</th>
<th>Type of behavioural additionality (Reported impact of participating in the government programme)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Network Additionality (More collaboration)</td>
</tr>
<tr>
<td></td>
<td>Follow-up Additionality (Project follow-up)</td>
</tr>
<tr>
<td></td>
<td>Management Additionality (Improved management)</td>
</tr>
<tr>
<td>Australia</td>
<td>67% formed new collaboration with another company. 48% formed new collaboration with universities or research institutes. 87% participated in subsequent government programmes. 70% introduced entrenched changes in R&amp;D management. 60% enhanced their commitment to R&amp;D. 56% improved their understanding of benefits of R&amp;D. 50% changed commercial strategy.</td>
</tr>
<tr>
<td>Austria (FFF)</td>
<td>51%/55% collaborated with public research organisations/other firms. 43% resulted in subsequent activities. 63% extended R&amp;D into new areas.</td>
</tr>
<tr>
<td>Austria (Kplus)</td>
<td>Firms recognised collaboration more important. 50% resulted in subsequent activities. 78% sell on international market. Share of R&amp;D funding spent externally doubled in four-year period. Larger share of participants engaged in EU-funded programmes.</td>
</tr>
<tr>
<td>Finland</td>
<td>53% strengthened collaborative networks. 50% collaborated with research institutes. 35% increased subcontracting.</td>
</tr>
<tr>
<td>Germany</td>
<td>78%/74% intensified collaboration with research institutes/industry. 42%/58% formed new collaboration with research institutes/industry. … but new networks do not necessarily last long after funding has ended. 66% changed R&amp;D management as a result of public funding procedures</td>
</tr>
<tr>
<td>Japan</td>
<td>—</td>
</tr>
<tr>
<td>Norway</td>
<td>60% increased collaboration. 63% resulted in subsequent activities. 29% established related projects. 21% of projects reached the stage of commercial application. 32% expanded R&amp;D department.</td>
</tr>
<tr>
<td>United States</td>
<td>More than 90% of joint ventures would not have formed without ATP support. 64% indicated that programme fostered increased trust and cooperation among partners.</td>
</tr>
<tr>
<td>EU</td>
<td>70% reported increased collaboration.</td>
</tr>
</tbody>
</table>

\(^{14}\) Source: Taken from Georghiou and Clarysse (2006)
2.3.3. The Recent Attempts

The OECD study played an important role to disseminate the concept of behavioural additionality to a wider range of scholars. After it was published in 2006, a number of consequent studies were produced. This section will analyse most of them while some of the evaluations of behavioural additionality that does not contribute to the conceptual framework will be skipped and included in the next chapter where the evaluation practice of behavioural additionality is investigated.

Gok (2006) analyses the concept and attempts to evaluate the behavioural additionality of the Turkish TUBITAK TIDEB programme by using the official monitoring data collected. Drawing on the caveats of this data, he also develops a monitoring and evaluation system for the programme.

In 2007, in a subsequent paper Georghiou (2007: 751) argues that “the behavioural additionality perspective opens the way to a much more comprehensive appreciation of effects and highlights the fact that, in supporting R&D with public funds, we should ultimately be concerned as much with building capacities as with short-term impacts”. According to him, survey-based methodologies are not capable of fully apprehending these kind of effects.

In the same year, Falk (2007: 666) extended the Austrian chapter of the OECD study. Intriguingly, she claims that “empirical evidence on behavioural additionality has remained sparse and mainly anecdotal until recently” because the necessary data is not readily available as it is for input and output additionality. Furthermore, she (2007: 668) argues that the literature on behavioural additionality “allude to econometric approaches but do not apply them”.

Falk (2007) makes an interesting classification of additionality summarised in Exhibit 6. According to her, the first of category of additionality is ‘resources-based concepts’ which includes (i) project additionality (if the project would have happened anyway), (ii) input additionality, (iii) scale additionality (if the project would have happened in a larger scale). The second category is result-based concepts, which cover (i) output additionality and (ii) impact additionality (if the productivity or the competitive position would have been improved anyway). The final category is behavioural additionality (or process based concepts) which includes (i) acceleration additionality (if the project would have happened faster), (ii) scope additionality (if the coverage of activities would have been more extensive) and finally (iii) cognitive capacity additionality. As depicted in Exhibit 6, scale additionality is shared between resource-based and scope-based concepts whereas scope additionality and cognitive capacity additionality are at the intersection of results-based concepts and process-based concepts.
Part I Chapter 2: Behavioural Additionality as a Concept of Innovation Policy Evaluation Literature

Exhibit 6: Falk’s (2007) Classification of Additionality\(^\text{15}\)

<table>
<thead>
<tr>
<th>Resource-based concepts</th>
<th>Result-based concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project A.</td>
<td>Scope A.</td>
</tr>
<tr>
<td>Input A.</td>
<td>Cognitive Capacity A.</td>
</tr>
<tr>
<td>Scale A.</td>
<td>Output A.</td>
</tr>
<tr>
<td>Acceleration A.</td>
<td>Impact A.</td>
</tr>
</tbody>
</table>

Process-based concepts (behavioural change)

It can be argued that Falk’s (2007) categorisation is marginal as the rest of the literature agrees on a different taxonomy, which includes input, output and behaviour additionality as broad categories. He refers to the rest of the concepts as sub-branches, but even so there is a debate as to how to allocate these concepts to the three broader ones.

Moreover, Falk (2007) falls into the infamous trap by arguing that “as behaviour is inherently intangible, it only becomes manifest in terms of results”. This point will be returned back in this thesis. There are a number of studies and evaluations that follow Falk’s definition including the extensive evaluation of behavioural additionality in the FP5 (IDEA Consult and Falk, 2009).

Busom and Fernandez-Ribas’s (2008) empirical paper, published in 2008 in Research Policy, in which they looked at the collaboration behaviour of Spanish firms by using panel data and employing econometric techniques, has contributed to the dissemination of the concept while it does not have much to contribute to the theorisation of the concept. Similarly, Hsu and his colleagues’ two closely related papers published in 2009 used the conventional definition of behavioural additionality to evaluate it in some particular setting by using advanced econometric methods (Hsu et al., 2009; Hsu and Hsueh, 2009).

Finally, Clarysse (2009) and his colleagues extend the OECD Belgium Study which drew on the original IWT study. They propose to understand behavioural additionality by the types of learning (experiential, congenital and inter-organisational). They use the indicators such as the number of projects financed by the programme at a specific firm, R&D intensity, and the number of project partners to evaluate these three types of learning respectively. I will return back to this research in Chapter 8.

\(^{15}\) Source: Taken from Falk (2007)
2.4. The Behavioural Additionality Puzzle

2.4.1. Different Understandings

While behavioural additionality has attracted quite an attention from the technology and innovation policy evaluation literature, for policy-makers and programme managers who would like to understand the impact of their policies/programmes on ‘firm behaviour’, the term still remains vague. The literature includes at least four categories of definitions, which are mostly overlapping and sometimes contradicting. These categories are summarised below and in Table 6.

A. Behavioural Additionality as an Extension of Input Additionality:

There are a number of papers that understand behavioural additionality as a very simple concept that complements the excessively linear and strict nature of input additionality. For instance, Luukkonen (2000: 713) argues “input additionality and behavioural additionality are usually merged together in a question that lists different degrees of additionality, whether the R&D would not have been carried out at all without public support, or alternatively whether the public funding changed the scale and scope of the R&D or R&D would have been done differently”. Similarly, Hsu and his colleagues use the very same definition in their closely related empirical articles (Hsu et al., 2009; Hsu and Hsueh, 2009).

Some other scholars accept that there might be further effects although they either put the emphasis on the extensions of input additionality or they find only this one workable (evaluatable). The fact that Falk (2007) defines behavioural additionality as a broad category that includes scope and acceleration additionality as well as cognitive capacity additionality and uses only the first two in his empirical investigation is an example of this. Another example is Malik et al. (2006: 206) who accept that behavioural additionality is a multi-layered concept; all the same, they use and prefer the simplistic definition. Finally, Georghiou (2002a: 59) defines behavioural additionality as the superset of scale, scope and acceleration additionality while accepting that there might be more permanent effects within the umbrella of behavioural additionality.

According to this definition category, behavioural additionality is not a persistent effect; it operates at only one point in time during the project. Nothing spills over and endures beyond the duration of support or its immediate vicinity.

It is clearly seen from the papers in this category that, behavioural additionality is perceived as confined to R&D and innovation activities of the term as well as the temporal limitation.

There is a further point worth discussing regarding to this category. As discussed in Section 2.2.3, the recent definitions of input and output additionality accept that (i) the simplistic definitions of these concepts are misleading and (ii) scale, scope and acceleration additionalities need to be
covered as part of evaluations as well as input and output additionality (English Partnerships, 2004, 2008; HM Treasury, 2003; Office of the Deputy Prime Minister, 2003). Therefore, it is fair to say that the main logic of this definition category, as to complete input additionality is now void as part of the mainstream policy evaluation literature akin to economics, has already recognised these effects within input and output additionality.

B. Behavioural Additionality as the change in the non-persistent behaviour related to R&D and innovation activities:

The second group of articles that define behavioural additionality sees the concept as the change in behaviour of the agents. This change, contrary to the Category A, is beyond an extension of input and output additionality. It not only includes scale, scope and acceleration additionalities but the way the project undertaken is also a subject of behavioural additionality.

The original definition of the concept is the prima example, Buisseret et al. (1995:590) coined behavioural additionality as “the change in a company’s way of undertaking R&D which can be attributed to policy actions”. Later, Georghiou (2002b:59) elaborates their definition by arguing that what they were inspired by while coining behavioural additionality was not the change in the “stop-go decision by the firm in respect of the project but [...] rather the way in which the project was carried out.” Similarly, Georghiou (2004:7) defines it as “the difference in firm behaviour resulting from the intervention”. Clarysse et al. (2006) and Steurs et al. (2006:6) endorse this and use it as a reinforcement of the use of the black-box analogy – behavioural additionality is what is inside the black-box left alone in between input and output additionality. Finally, Hall and Maffioli (2008: 173) use this definition in their empirical investigation.

Similar to the definition category A, the studies used this in category B do not imply any persistency. The change in the behaviour does not need to endure beyond the project or its immediate vicinity. Clarysse et al. (2006) and Steurs et al. (2006:6) hint at the persistence but, as it will be discussed later on, their temporal understanding are still more short-term-like than the definition categories C and D below. In a similar vein, Georghiou (1998: 39) and Davenport et al. (1998: 56) accept that behavioural additionality is “the most durable” amongst the three types of additionality but not quite enough compared to the next two categories. Secondly, this category is also confined to the behaviour related to R&D and innovation activities.
C. Behavioural Additionality as the change in the persistent behaviour related to R&D and innovation activities:

The third category of definitions of the concept of behavioural additionality is very similar to the second one with the only difference of the element of persistence.

Aslesen et al. (2001:5-6) define it as the “permanent change”, Licht (2003) as the change “permanent in character”, and OECD (2006a:187-189) as the “more sustained effects”. Fier et al. (Fier et al., 2006: 127) prefer to use “long-term behaviour”. Busom and Fernandez-Ribas (2008) define it as the change in the propensity to exhibit a particular behaviour. In all these definitions, persistence is the key point; these effects endure beyond the support period.

D. Behavioural Additionality as the change in of the general conduct of the firm:

The first feature in this category is that the change is not necessarily confined to R&D and innovation related activities but behavioural additionality is defined as the change in the general conduct of the firm. Secondly, behavioural additionality is defined in its widest temporal breadth - it endures long after the support.

Most importantly, the definitions of behavioural additionality include more structural changes as they refer to the change in the building blocks of behaviour. The most explicit attempt to do this is by Georghiou and Clarysse (2006:12-13) who employed the resource based view of the firm and implied that behavioural additionality refers to changes in the dynamic capabilities. Nonetheless, the effort was not enough to present a coherent and extensive framework as discussed earlier in this chapter. Another attempt is by Bach and Matt (2005:37) who defined a new category of cognitive capacity additionality. Although they put this type of additionality as a fourth kind by defining behavioural additionality in category B, it is clear that what they refer is considered as a part of behavioural additionality. As a matter of fact, Hyvarinen and Rautiainen (2007: 206) later adopted this approach while defining behavioural additionality as “how public R&D funding affects the firm’s behavior, cognitive capacity and learning”. Some other scholars define behavioural additionality as the change in organisational routines (Georghiou, 2007; Georghiou and Keenan, 2006) but do not articulate their definitions. Finally, Clarysse and his colleagues’ definition (2009) utilises the concept of learning to define behavioural additionality.
### Table 6: Comparison of Different Definitions of Behavioural Additionality

<table>
<thead>
<tr>
<th>Definition</th>
<th>Category A</th>
<th>Category B</th>
<th>Category C</th>
<th>Category D</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
<td>An extension of input additionality covering scale, scope and acceleration additionalities and like</td>
<td>The change in the non-persistent behaviour related to R&amp;D and innovation activities</td>
<td>The change in the persistent behaviour related to R&amp;D and innovation activities</td>
<td>The change in of the general conduct of the firm</td>
</tr>
<tr>
<td><strong>Coverage</strong></td>
<td>Only R&amp;D and innovation</td>
<td>Only R&amp;D and innovation</td>
<td>Only R&amp;D and innovation</td>
<td>Beyond R&amp;D and innovation</td>
</tr>
<tr>
<td><strong>Persistence</strong></td>
<td>One-off, no persistence</td>
<td>One-off, no persistence OR Rather mid-term than long-term and rather less persistent</td>
<td>Persistent OR Rather long-term than short-term and rather more persistent</td>
<td>Persistent</td>
</tr>
<tr>
<td><strong>Main Sources</strong></td>
<td>(Luukkonen, 2000)</td>
<td>(Buisseret et al., 1995:590)</td>
<td>(Lenihan et al., 2007: 317-318)</td>
<td>(Clarysse et al., 2009)</td>
</tr>
<tr>
<td></td>
<td>(Hsu et al., 2009; Hsu and Hsueh, 2009)</td>
<td>(Georghiou, 2002b:59)</td>
<td>(Aslesen et al., 2001: 5-6)</td>
<td>(Georghiou, 2007: 744)</td>
</tr>
<tr>
<td></td>
<td>(Malik et al., 2006)</td>
<td>(Clarysse et al., 2006)</td>
<td>(Licht, 2003)</td>
<td>(Bach and Matt, 2005: 37)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Hall and Maffioli, 2008: 173)</td>
<td>(Fier et al., 2006: 127)</td>
<td>(Georghiou and Keenan, 2006: 770)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Davenport et al., 1998: 56)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 2.4.2. Common Grounds

Since these definition categories have many characteristics in common, the demarcating line between them is not clear-cut. Firstly, all of the definitions have an aim to go beyond the input-output approach. The analysis of this literature summarised in Table 6 reveals the limitations of input-output bounded approach as it tends to evaluate what is measurable rather than what should be measured. Most of the studies apply the black-box analogy and introduce behavioural additionality as the change in its content. Similarly, most of the literature associates its definition with project fallacy which simply refers to the fact that the majority of studies often evaluate the
Part I Chapter 2: Behavioural Additionality as a Concept of Innovation Policy Evaluation Literature

project that is supported by the government although R&D activities of the firm often start before and finish after the grant (Georghiou, 2002a; Georghiou et al., 2002; OECD, 2006a, 2006b).

These studies on behavioural additionality have accomplished important achievements in the domain of technology and innovation policy evaluation. Firstly, they have contributed to the visibility and popularity of the additionality framework. Secondly, they have contributed to the awareness that the government policy should be pro-active. Because the OECD project undertaken in 2006, which includes 12 pilot studies from 11 member countries and the EU, has attracted considerable interest, behavioural additionality has taken its place on the agenda of the public support organisations. Thirdly, behavioural additionality has become a pioneering concept challenging the understanding over evaluation that it should focus on what is considered measurable. Finally, the concept of behavioural additionality has contributed to close the under-investment gap, which is due to under-evaluation (Aho et al., 2006; Georghiou, 2007).

These definitions and conceptualisations of behavioural additionality, however, cannot fully accomplish the aim they are meant for. As a concept formulated to fill the black-box gap, the literature itself treats the concept as another black-box. The definitions and practise of evaluation of behavioural additionality does not take into consideration the building blocks of what they call ‘behaviour’. Rather, they define some important behaviour patterns to their interest. In other words, all the definitions and the scope of studies are set functionally and on ad hoc basis at the expense of a loss in the overall conceptual depth. As these possible ‘behaviour’ have not been universally defined, the literature not only lacks a consensus over what is ‘behaviour’ and what is behavioural additionality but also a common ground to evaluate what is already defined as behavioural additionality.

Collaboration, for example, is considered as a central issue in most of the behavioural additionality studies (Busom and Fernandez-Ribas, 2008; Clarysse et al., 2006; Department of Industry Tourism and Resources of Australia, 2006; Falk, 2006; Fier et al., 2006; Georghiou and Clarysse, 2006; Georghiou and Roessner, 2000; Hyvärinen, 2006; Madsen and Brastad, 2006; Malik et al., 2006; Polt and Psarra, 2006; Shin, 2006; Shipp et al., 2006; Steyer, 2006; Suzuki and Yumitori, 2006). However, all of these studies take the collaboration behaviour as a black-box, which takes some inputs (government support) and in return creates some outputs (more collaboration). Both the input and the output are measurable in this case. Nevertheless, none of the studies goes further and analyses the mechanism of the building blocks of the behaviour that changed because of the government support and produced a different level of collaboration.

Going ahead with the black-box analogy, therefore, the current conceptualisation and evaluation of behavioural additionality successfully opens up the big black-box of the firm. However, it fails
to understand what is inside and creates further smaller black-boxes within the bigger one. In that level, furthermore, the same mistake to which the concept has been created as a reaction is repeated: the current evaluation practice of behavioural additionality tries to grasp these smaller black-boxes in line with the neoclassical paradigm, which explores the bigger black-box of the firm.

What is needed, therefore, is to open up these smaller black-boxes, namely behaviour, until a reasonable unit of analysis is reached. Behavioural additionality, then, would be explained in terms of the change and interaction of these building blocks. My suggestion is to use the unit of analysis of organisational routines for this purpose.

**2.5. Conclusion**

This chapter attempts to outline the literature on behavioural additionality from the angle of evaluation. As a starting point, a broader literature review on the concept of additionality has been undertaken, which yielded interesting results. Firstly, it is clear that despite being a very technical and narrow concept, additionality is used in a number of different domains. Taking its roots from EU’s aggregate principle of additionality, it is at the core of environmental economics at the project level, while programme level evaluation of additionality is a central task of evaluation of the mainstream policies akin to economics. On the other hand, mainstream evaluation literature allied to sociology implicitly applies the logic of additionality not only in experimental and quasi-experimental designs but also in non-experimental designs. Additionality in the technology and innovation policy evaluation literature, finally, is evaluated in three different types of input, output and behavioural additionality.

A survey of the literature on the behavioural additionality revealed that there is no common methodology or approach to evaluate the concept. Behavioural additionality is evaluated qualitatively by using case studies while quantitative approaches utilised by quasi-experimental designs are also used to evaluate the concept. The analysis of the practice in the next chapter will shed more light on this issue.

It is also evident in the scholarly literature that behavioural additionality has been defined ambiguously in four conflicting definition categories, leaving the main difficulty as the lack of unit of analysis that could explain both the change and stability. Following the lead of certain scholars, the direction of organisational routines as the unit of analysis of behaviour and thus behavioural additionality has emerged as the main conclusion of this chapter.
Part I

Chapter 3: Behavioural Additionality as a Concept of Innovation Policy Evaluation Practice
3.1. Introduction

It is imperative to understand the practice of additionality evaluation to study the concept of behavioural additionality. After all, evaluation is a practical field and theory should feed into practice. The only way for the theory-builder to do this, consequently, is to understand the state of the practice. Therefore, the aim of this chapter is set to explore evaluation practice of additionality within the domain of innovation policy.

This chapter has three reinforcing objectives:

(i) To survey the characteristics of evaluations that cover behavioural additionality by investigating the nature of behavioural additionality evaluations according to evaluated measure characteristics, various evaluation characteristics and finally perceived quality and usefulness of evaluations.

(ii) To outline the difference between evaluations covering behavioural additionality and the ones not covering it. By doing this, deriving correlations between various characteristics and behavioural additionality would be possible.

(iii) To understand how behavioural additionality is perceived and used in the evaluation practice.

The first and second objectives are important in order to understand not only behavioural additionality’s relationship with other evaluation characteristics, but also its distinct features. Similarly, the third objective will shed more light on the vague definition of the concept of behavioural additionality as discussed in detail in Chapter 2.

The analysis will be conducted by using data collected by the INNO-Appraisal project in which I have also invested a significant amount of time since its inception. I have been extensively involved in all of the conceptual and empirical steps and organised the data collection process as part of the coordinating team. Within the scope of the INNO-Appraisal project, along with the project coordinator Prof Jakob Edler, I conducted a case study on behavioural additionality (Gok and Edler, 2010) which partially overlaps with this chapter. This case study has reproduced some parts of this chapter. Nevertheless, any analysis and argumentation presented herein is original and my own work. Any material that is not my own and sole work within the INNO-Appraisal project is cited accordingly.

The chapter plan is as following: section 2 will outline the project and provide data specifications. The quantitative data analysis results will be discussed in section 3. Section 4 will present the text analysis and section 5 will conclude.
3.2. Data and Analysis Specifications

The data used in this chapter is from the INNO-Appraisal project, which ran between April 2007 and April 2010 and was coordinated by Manchester Institute of Innovation Research (formerly PREST)\(^\text{16}\) and participated by ATLANTIS Consulting, Greece, Joanneum Research, Austria, Fraunhofer Institute Systems and Innovation Research, Germany and Wise Guys Limited, UK. The dual objectives of the project were:

(i) to compile, assess and analyse all relevant evaluation exercises across the EU
(ii) to learn how evaluation practice can be improved and how policymaking can benefit from the practice of evaluation (INNO-Appraisal, 2010).

To accomplish its aims, the project identified all of the evaluation studies for the innovation policy measures / programmes of EU25 countries based on the INNO-Policy Trendchart database of policy measures. The project team, then, collected reports for these evaluations and characterised them by filling in an extensive 7-page template for each evaluation in the INNO-Appraisal database that was conducted between 2002 and 2007\(^\text{17}\). The process is shown in Exhibit 7 (Gok et al., 2007).

The INNO-Appraisal data collection process ended in 2009. The database includes 172 evaluations from 25 European countries. All of the templates were pre-filled in by the partners of the project and by their correspondents where partners did not know the local language. Consequently, pre-filled in templates were sent to respective policy-makers for verification. Approximately two thirds of the templates were returned from policy-makers (INNO-Appraisal, 2009).

The INNO-Appraisal database covers the bulk of the evaluations of innovation policy measures evaluated between 2002 and 2007. The project is based on the comprehensive INNO-Policy Trendchart database of policy measures, and the data collection process has further elaborated this base. Therefore, it can be argued that the INNO-Appraisal results would show a highly realistic picture of the field of innovation policy evaluation at the EU25 level.

Among other characteristics, the INNO-Appraisal investigated if evaluations covered particular evaluation topics (particular questions that the evaluation aims to answer). Out of 15 different topics of evaluation, three of them are input, output and behavioural additionality – the three types of additionality introduced in the previous chapter. As the main aim of the analysis is to explore the distinct features of additionality, and in particular behavioural additionality, this

\(^{16}\) where I also belong to.
\(^{17}\) The template can be found at [http://www.proinno-europe.eu/appraisal](http://www.proinno-europe.eu/appraisal)
chapter will look at several cross tabulations of three types of additionality along with the other characteristics of evaluations. It also investigates if these evaluations covering input, output and behavioural additionality are statistically significantly different than the whole set (and hence from the evaluations that do not cover any type of additionality) in terms of evaluation characteristics.

As established from the review of the scholarly literature on this topic in the previous chapter, the difference between the traditional types of additionality (input and output additionality) and behavioural additionality is vague as i) these three concepts are intertwined and also ii) various approaches to behavioural additionality define various relationship between these three. Therefore, throughout the chapter, rather than analysing behavioural additionality exclusively, all three concepts of additionality will be analysed and also compared.

In this chapter, the whole dataset will be compared with the three smaller subsets of evaluations covering input, output and behavioural additionality with respect to the following main evaluation characteristics featuring in the INNO-Appraisal Data Collection Template\(^\text{18}\):

- Timing of evaluation
- Purpose of evaluation
- Budget, planning and sponsorship and tendering of evaluation
- Impacts looked at in evaluation
- Main evaluation designs
- Main data collection methods and data sources employed in evaluation
- Main data analysis methods used in evaluation
- Main intended audiences for evaluation
- Terms of reference availability
- Quality of evaluation
- Usefulness of recommendations of evaluation
- Discussions of evaluation
- Consequences of evaluation

Methodologically, for categorical cross-tabulations a Chi-Square test at 90% confidence is employed while for correlations a Pearson or Spearman test at 90% confidence is used. All the significant associations and correlations are indicated. All the data tables and graphs are presented in the Annex and they show the cross-tabulations of evaluations covering different types of additionality and other evaluation characteristics which give the overall figure for that particular characteristic (e.g. share of ex-ante evaluations) and also figures for those evaluations covering different types of additionality (e.g. share of ex-ante evaluations within the subset of

\(^{18}\) See [http://www.proinno-europe.eu/appraisal](http://www.proinno-europe.eu/appraisal) for the template.
evaluations covering behavioural additionality). For contractual reasons, INNO-Appraisal project used the terms ‘evaluation’ and ‘appraisal’ interchangeably. Therefore, some of the references to the term appraisal especially in the data tables and graphs should be read as evaluation.
Exhibit 7: Data Collection Process of the INNO-Appraisal Project\textsuperscript{19}

\textsuperscript{19} Taken from Gok et al. (2007).
3.3. Data Analysis Results

3.3.1. Coverage of Additionality

As outlined in Exhibit 8, about 50% of evaluations covered behavioural additionality, output additionality and input additionality. The first observation here is that behavioural additionality has gained a place for itself. Although it is relatively new concept compared to the more established concepts of output and input additionality, the uptake of the former is not less than the latter ones. Secondly, in spite of the fact that there are clearly more popular evaluation topics than (any kind of) additionality, they are not marginal or outlier topics in terms of their uptake.

Exhibit 8: Uptake of Additionality as a Topic of Evaluation in EU25 National Innovation Programme Evaluations

<table>
<thead>
<tr>
<th>Topic</th>
<th>Uptake (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c7e Outputs, Outcomes and Impacts</td>
<td>92%</td>
</tr>
<tr>
<td>c7d Goal Attainment/Effectiveness</td>
<td>89%</td>
</tr>
<tr>
<td>c7b Internal Consistency</td>
<td>80%</td>
</tr>
<tr>
<td>c7a External Consistency</td>
<td>79%</td>
</tr>
<tr>
<td>c7m Policy/Strategy Development</td>
<td>76%</td>
</tr>
<tr>
<td>c7h Programme Implementation Efficiency</td>
<td>76%</td>
</tr>
<tr>
<td>c7c Coherence/Complementarity</td>
<td>62%</td>
</tr>
<tr>
<td>c7f Quality of Outputs</td>
<td>57%</td>
</tr>
<tr>
<td>c7l Behavioural Additionality</td>
<td>50%</td>
</tr>
<tr>
<td>c7k Output Additionality</td>
<td>50%</td>
</tr>
<tr>
<td>c7j Input Additionality</td>
<td>50%</td>
</tr>
<tr>
<td>c7i Project Implementation Efficiency</td>
<td>47%</td>
</tr>
<tr>
<td>c7g VfM/RoI/CBE</td>
<td>27%</td>
</tr>
<tr>
<td>c7n Gender issues</td>
<td>24%</td>
</tr>
<tr>
<td>c7o Minority issues</td>
<td>7%</td>
</tr>
</tbody>
</table>
Exhibit 9 shows the relationship between the evaluations covering the three types of additionality and also the remaining evaluations that do not cover any type of additionality. Two-thirds of the national innovation policy measure evaluations in the database cover at least one form of additionality, and one-third of evaluations cover all three types of additionality. Those covering behavioural additionality exclusively constitute only one-fifth of all behavioural additionality evaluations. This picture, therefore, suggests that the three types of additionality are used extensively and they are predominantly used together. Gok and Edler (2010) reveal that three types of additionality are generally evaluated together as behavioural additionality is most often used as a justification when programmes could not prove input and output additionality.

Exhibit 10 further confirms this picture as it shows the illustration of the results of the clustering analysis of the evaluation topics. As can be read from the dendrogram, input, output and behavioural additionality clearly form a cluster – they tend to be used together in evaluations. These three types of additionality are mostly linked with the cluster of topics formed by ‘quality of outputs’ and ‘project implementation efficiency’, while there is no close link to ‘programme implementation efficiency’. This is not surprising considering the fact that behavioural additionality is especially linked with the micro level, i.e. the firm or even project level, the way a project is conducted or actions and routines are changed, and with the immediate difference this makes for the output (quality). This also points to the differences between evaluations that are more closely related to the project level and those that are more interested in the programme level efficiency, as the two are not closely linked.
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Interestingly, the cluster formed by the three types of additionality is not very closely related to topics such as ‘outputs, outcomes and impacts’. This seems to indicate that the additionality dimensions are not simply add-ons to the traditional output and impact dimension, but often used independently.

Exhibit 10: Dendrogram of Topics Covered in Evaluations using Average Linkage (Between Groups)²⁰

³.3.2. Characteristics of Additionality Evaluations: A Synthesis

The survey of the practice for the characteristics of additionality evaluations is presented in this section. As the aim is to shed more light into behavioural additionality as explained above, the synthesis of the results is presented below. Detailed tables and graphs, on which these results are based, are presented in Annex 1.

Geographical Distribution: All three types of additionality tend to be seen in more developed evaluation cultures such as Austria and the UK (Exhibit 24 and Table 20 in Annex 1).

Types of Policy Measures: Behavioural additionality evaluations are predominantly for the measures aimed at direct financial support (around 54%), innovation management support and dissemination, innovation culture (around 33%) and Networks & Clusters, collaboration and

²⁰ Rezankova (2009) recommends ‘Jaccard’s co-efficient’ or ‘Yule’s Q’ measures for object clustering (clustering of variables of same type) of dichotomous (variables that take binary options) asymmetric (‘1’ and ‘0’ values are of inherently different importance) variables. This method does not cluster variables on the basis of co-absence of same trait (i.e. both variables takes the value ‘0’ at the same time). In this analysis, furthest neighbour method which links topics with complete linkage is used by applying Jaccard’s co-efficient measure.
Technology/Knowledge Transfer (around 40%). Furthermore, there are not many significant
differences between the whole set and the behavioural additionality subset in terms of the types
of measure they are associated with (Exhibit 25 and Table 21 in Annex 1).

Structural Funds and Portfolio Evaluations: Some of the evaluations in the INNO-Appraisal
database cover more than one policy measure. These portfolio evaluations are most often for
policy measures associated with EU structural funds. Behavioural additionality is less likely to be
covered in structural fund and portfolio evaluations. This might suggest that as structural fund
evaluations are imposed by the European Union and they investigate the strategic impact in the
macro level. Behavioural additionality – a topic that is used as policy and operational learning and
a topic that is generally considered as micro – is not embraced by structural fund evaluations
(Exhibit 26 and Table 22 in Annex 1).

Types of Evaluators and Tender Processes: Behavioural additionality evaluators are
predominantly external evaluators selected mostly with open tender procedures. This might be
due to the fact that input and output additionality evaluations are generally perceived as hard-to-
conduct as to their methodologies, which involve sophisticated econometric techniques with
quasi experimental designs. In non-closed tender processes (internal and open), it might be
perceived that the choice of evaluator is limited to those quantitatively focused evaluators that
lack the context knowledge and thus the ones that have the context knowledge but lack the
sophisticated and sometimes experimental econometric knowledge are excluded. Therefore, the
issuers of evaluation contracts might need to control the process against this kind of bias by
making the tender process closed. Another explanation can be that internal evaluators are not as
familiar with behavioural additionality as with other concepts, which also confirms the result for
the choice of evaluator (Exhibit 27, Exhibit 28, Table 23 and Table 24 in Annex 1).

Timing of Evaluations: The distribution of timing options is statistically significantly different for all
three types of additionality. Evaluations which cover any type of additionality are more often ex-
post, and less often accompanying, ex-ante and interim than other evaluations. This points to the
long-term nature of additionality effects. Furthermore, behavioural additionality is not linked with
accompanying evaluations as much as one would expect. A good accompanying evaluation should
rely on behavioural additionality based on monitoring data, as this would allow re-engineering and
re-enforcement of the desired effects while the programme is running. Therefore, it can be
argued that real-time evaluation dimension of behavioural additionality is still under-explored
(Exhibit 29 and Table 25 in Annex 1).

Purpose of Evaluations: All three types of additionality evaluations are statistically significantly
different from the whole set, as they are less formative and more summative and mixed type. As
per behavioural additionality, although it is less formative than the whole set, it is more formative
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than input and output additionality. Yet, the same applies as above, behavioural additionality is
not as formative as one would expect or as the concept itself offers (Exhibit 30 and Table 26 in Annex 1).

Evaluation Budget: Around two-fifths of the additionality evaluations had a budget planned from
the design phase of their associated measures (Exhibit 31 and Table 27 in Annex 1).

Planned Evaluations: Almost 70% of the evaluations that covered input and output additionality
evaluations were foreseen and planned upfront while this ratio is even higher for evaluations that
covered behavioural additionality (Exhibit 32 and Table 28 in Annex 1).

Impacts looked at in Evaluations: Around half of behavioural additionality evaluations looked at
scientific impact, around three quarters at technological impacts, around 80% at economic
impacts, around half at social impacts and only a quarter at environmental impacts. For scientific
and technological impacts these ratios are statistically significantly higher than the whole dataset.
This implies that behavioural additionality has been linked with knowledge creation at least as
much as it is linked with value creation (Exhibit 33 and Table 29 in Annex 1).

Evaluation Sponsors: All three types of additionality evaluations were predominantly sponsored
by programme owner / manager. However, there are no significant biases against, or in favour of,
additionality aspects in any of the potential sponsors; additionality is not imposed by external
sponsors (Exhibit 34 and Table 30 in Annex 1).

Quasi-Experimental Evaluation Designs: Within the whole sample, only one quarter employed a
cost-benefit approach, approximately one-fifth used counter-factual and/or control group
approach and only one-tenth utilised before-after group comparison.

The figures are statistically significantly higher for input and output additionality that employed
these approaches heavily more than the whole set - around three quarters of these two subsets
employed these designs. The margins are higher for input additionality than output additionality.

For behavioural additionality, the situation is somewhat puzzling. Despite the percentage of
evaluations employing these designs in behavioural additionality being slightly higher than that of
the whole set, the only difference in the counter-factual approach is statistically significant. This
might be due to the fact that behavioural additionality evaluations rely on non-experimental
designs rather than quasi-experimental ones. Similarly, while input and output additionality are
closely linked with cost-benefit dichotomy, behavioural additionality is not particularly linked to it.
This is another indication that behavioural additionality is not as strongly linked to immediate
economic effects as the other two forms, reflecting the indirect – and underestimated – effect of
change in behaviour on outcome (Exhibit 35 and Table 31 in Annex 1).
Data Collection Methods and Sources: Behavioural additionality evaluations utilised interviews (89%, significantly more than the others), monitoring data (80%), participant surveys (about 82%, significantly more than the others), existing surveys/databases (73%), document search (64%), non-participant surveys (35%, significantly more than the others), peer-reviews (20%) and technometrics/bibliometrics (2%) as data collection methods.

It appears that for key methods there is a striking difference not only between behavioural additionality and the whole sample, but also between behavioural additionality and the other two additionality concepts, while those two appear to be highly similar in terms of the data methods used. Most significantly in a statistical sense, behavioural additionality evaluations use more often interviews and surveys, while they rely on them slightly less (if not significantly) than other types of additionality, and the sample as a whole on existing survey and data.

This picture both endorses and contradicts the rather strong claim that behavioural additionality cannot be understood only and exclusively by survey based evaluations (c.f. Georghiou (2007)). On one hand, behavioural additionality evaluations need more in-depth data collection practices like interviews than other evaluations. On the other hand, the majority of behavioural additionality evaluations generally utilised quantitative methods such as monitoring data, existing and new surveys. This might be due to the fact that, as discussed above, behavioural additionality is rarely evaluated exclusively and complementary data collection methods are needed to evaluate all three types of additionality separately and as a whole. Finally, the less pronounced use of existing data is logical, as existing data is rarely collected for the purpose of behavioural additionality and thus lacks important variables and dimensions, while data needed for input and output additionality is more in line with widely available statistics (Exhibit 36 and Table 32 in Annex 1).

Data Analysis Methods: The main data analysis methods for behavioural additionality were descriptive statistics (97%, significantly more than the others), context analysis (59%), document analysis (51%), case study analysis (46%), input-output analysis (27%), econometric analysis (32%, significantly more than the others) and network analysis (24%, significantly more than the others). In addition, behavioural additionality deviates in some aspects of methods from input and output additionality evaluations, the former employing interviews and surveys more often.

One of the most startling results in this chapter is that although the ratio of evaluations using the case study analysis is slightly higher for evaluations that cover behavioural additionality (46%) than the whole data, the association between the case study analysis and behavioural additionality is weak. This is extremely puzzling on the face of the results discussed above: behavioural additionality evaluations utilise non-experimental methods as they use interviews significantly more but at the same time their link to case study analysis is not as strong as one would expect.
One could only explain this with the probability that behavioural additionality evaluations predominantly use qualitative methodologies, but as the question of behavioural additionality is quite complex and situation-dependant, the data is collected through interviews or surveys or both (Exhibit 37 and Table 33 in Annex 1).

**Main Intended Audiences of Evaluation:** The main intended audiences of evaluation in the INNO-Appraisal sample were programme management (98%), government officials (98%), politicians (65%), financial authorities (52%), policy analysts (58%), those directly supported by measures (53%), external sponsor of programmes (41%), potential users of measures (40%) and finally the general public (31%). For input and output additionality, these ratios are statistically significantly higher for financial authorities (around 10% higher), policy analysts (around 10% higher), potential users (around 10% higher) and those directly supported by the measure (around 15% higher). The last two categories are also higher for behavioural additionality (around 10% higher). Similarly, for behavioural additionality the ratio of general public is 10% more than that of the whole set. This slight emphasis on the potential and actual users of the measures is probably due the reason that the question ‘what difference does it make?’ of additionality is most relevant to these categories of audiences. Furthermore, the fact that behavioural additionality is less associated with the auditors/financial authorities supports the previous finding that the financial and (tangible) economic implications of behavioural additionality are less obvious, and that auditors struggle with quantifying – and thus appreciating – the effects (Exhibit 38 and Table 34 in Annex 1).

**Terms of References of Evaluations:** Among those evaluations where their terms of reference were available, 94% of them clearly stated the objectives. Similarly, 36% of evaluations specified the methodologies and approaches in their terms of references. One implication here is that behavioural additionality is mostly a specified and client-driven topic of evaluation (Exhibit 39 and Table 35 in Annex 1).

**Perceived Quality of Evaluations:** The quality of evaluations in the different categories of quality is generally perceived as high by policy-makers (Exhibit 40 and Table 36 in Annex 1). Evaluations in the behavioural additionality subset are more or less with the same quality with the other evaluations except a few slight differences. The difference for three additionality dimensions is presented in Table 7.
Table 7: Summary of the Perceived Quality of Additionality

<table>
<thead>
<tr>
<th></th>
<th>Input Additionality Subset</th>
<th>Output Additionality Subset</th>
<th>Behavioural Additionality Subset</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>d1d If Terms of Reference are given, does the appraisal address them?</strong></td>
<td>no statistical difference</td>
<td>no statistical difference</td>
<td>no statistical difference</td>
</tr>
<tr>
<td><strong>d3a Was/Is the design of the evaluation appropriate given the objectives of the evaluation and the nature of the policy measure?</strong></td>
<td>higher</td>
<td>no statistical difference</td>
<td>no statistical difference</td>
</tr>
<tr>
<td><strong>d4a Did/Do the methods chosen satisfy the Terms of Reference/purpose of the appraisal?</strong></td>
<td>higher</td>
<td>no statistical difference</td>
<td>no statistical difference</td>
</tr>
<tr>
<td><strong>d5a Was/Is the application of the qualitative methods satisfactory?</strong></td>
<td>higher</td>
<td>no statistical difference</td>
<td>higher</td>
</tr>
<tr>
<td><strong>d6a Was/Is the application of the quantitative methods satisfactory?</strong></td>
<td>higher</td>
<td>higher</td>
<td>higher</td>
</tr>
<tr>
<td><strong>d7a Were/Are the information sources used in the report well documented and referenced?</strong></td>
<td>no statistical difference</td>
<td>no statistical difference</td>
<td>no statistical difference</td>
</tr>
<tr>
<td><strong>d8a Was/Is the analysis clearly based on the data given?</strong></td>
<td>higher</td>
<td>higher</td>
<td>higher</td>
</tr>
<tr>
<td><strong>d9a Given the objectives of the appraisal, does the analysis cover the broader context (e.g. societal, institutional, policy and ecoNomic contexts) sufficiently?</strong></td>
<td>higher</td>
<td>no statistical difference</td>
<td>no statistical difference</td>
</tr>
<tr>
<td><strong>e1a Were/Are the conclusions based on the analysis?</strong></td>
<td>higher</td>
<td>higher</td>
<td>higher</td>
</tr>
</tbody>
</table>

Perceived usefulness of recommendations: In general, the usefulness of recommendations for the evaluations was not perceived highly compared to, for example, quality. All three subsets of additionality scored slightly lower than the general dataset, which implies no significant difference in terms of the usefulness of recommendations. Input additionality is, to a small scale, negatively correlated with usefulness of recommendations regarding ‘management and implementation of the programme design’. Behavioural additionality evaluations, despite being not more useful than the whole dataset, were slightly more useful than input and output additionality evaluations. In other words, behavioural additionality is the most useful of all three kinds of additionality evaluations, which are not in fact more useful than other evaluations (Exhibit 41 and Table 37 in Annex 1).

Consequences of Evaluations: The scope of the evaluations’ discussion within government circles scored 3.37 in the 5-point Likert scale used above. Similarly, discussions with stakeholders scored 3.35. These results imply that it is perceived that considerable attention to evaluation is given by the government officials and wider stakeholders which, however, seems to have room for
improvement. Evaluations that cover behavioural additionality are discussed more widely than the whole dataset, both within government and – more pronounced even – with stakeholders more widely, which is consistent with the finding that behavioural additionality is statistically significantly associated with audiences such as general public and beneficiaries. Interestingly, output additionality is not discussed more broadly within or outside government circles, contrary to the general belief that discussion on innovation policy focuses mainly on output (Exhibit 42 and Table 38 in Annex 1).

Within the INNO-Appraisal sample, only a tiny fraction of evaluations led to the termination of measures (circa 3%). The share of measures that have undergone a minor and major re-design because of evaluation is 46% and 8%, respectively. Input and output additionality subsets tend to result in statistically significantly less minor re-design than the whole dataset. The percentages for ‘expansion / prolongation of the measure’, ‘re-design of another measure’ and ‘merger of measures’ are 37%, 17% and 11%, respectively for the whole sample. For both prolongation/expansion and re-design of another measure, all three additionality subsets yield statistically higher ratios. Behavioural additionality’s strong association with the expansion/prolongation of the related measure could indicate that the concept helps policymakers understand that time is needed for behavioural changes to show effects at the innovation end, and – in addition – that it is used for legitimisation (Exhibit 43 and Table 39 in Annex 1).

3.4. Text Analysis

As outlined in the previous chapter, there are a number of different and sometimes conflicting understandings for behavioural additionality in the scholarly literature (Section 2.4.1 and Table 6 above). This result established in the previous chapter is worth a further investigation in the practice for at least two reasons. First, it is important to see how behavioural additionality is really understood in an applied real-life context. Secondly, to be able to develop a new theoretical/conceptual framework, it is imperative to understand how discussions in the scholarly literature influence perceptions in practice.

Carrying the analysis presented in detail in the previous chapter further, evaluation reports covering behavioural additionality are analysed as to their understanding of the concept. 33 reports out of 81 evaluations, which cover behavioural additionality, were looked at for the definition and usage of the concept of behavioural additionality. The rest could not be analysed either because they are in an unfamiliar language or their quality do not allow an in depth analysis. The strategy and template for the text analysis is prepared by the author. Similarly, English language reports were analysed by him. This accounted for the 24 out of 33 reports. Six German,
one Danish and two Spanish language reports were analysed in the context of the INNO-Appraisal study by other researchers (Gok and Edler, 2010).

The text analysis of the 33 reports that covered behavioural additionality investigated the following important dimensions that were featured in the analysis of the scholarly literature conducted in Chapter 2:

- if behavioural additionality is explicitly mentioned or used implicitly
- the running definition of behavioural additionality
- if the implicit or explicit definition of behavioural additionality includes the elements of persistency
- if the implicit or explicit definition of behavioural additionality covers only R&D behaviour or confines its coverage to collaboration behaviour
- if there are any references to the building blocks of behaviour

The analysis revealed that the typology of the different understandings for behavioural additionality in the practice is quite similar to that of the scholarly literature with a few minor adjustments. Firstly, the two distinct categories of approaches to behavioural additionality such as ‘the extension for input and output additionality’ (category A) and ‘the change in the non-persistent behaviour related to R&D and innovation activities’ (category B) form a single category in the practice (category A+B) as it was not possible to distinguish category A from Category B in most cases. Similarly, for those evaluations which are quite close to the category of behavioural additionality as ‘the change in the persistent behaviour related to R&D and innovation activities’ (category C) but also include some references to building blocks, a new version of category C (category C2) is created.

The analysis further revealed that these four adjusted categories were shared more or less equally by evaluations. Furthermore, there is a clear link between the scope of the behaviour they investigate and the definition category. For instance, while category A+B evaluations are mostly limited to collaboration behaviour, Category D evaluations have a much wider scope. Finally, evaluations that embrace definition category D use the concept of behavioural additionality more explicitly than the evaluations employed other definitions.
### Table 8: Classification of Definitions of Behavioural Additionality in the Practice

<table>
<thead>
<tr>
<th></th>
<th>Category A + B</th>
<th>Category C1</th>
<th>Category C2</th>
<th>Category D</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
<td>The non-persistent extension of input additionality OR the change in the non-persistent behaviour</td>
<td>The change in the persistent behaviour</td>
<td>The change in the persistent behaviour with minor references to building blocks</td>
<td>The change in the general conduct of the firm, reference to building blocks of behaviour</td>
<td>Inconsistent OR not possible to analyse</td>
</tr>
<tr>
<td><strong>Coverage</strong></td>
<td>Only R&amp;D and innovation</td>
<td>Only R&amp;D and innovation</td>
<td>Only R&amp;D and innovation</td>
<td>Beyond R&amp;D and innovation</td>
<td>(Some of Them)</td>
</tr>
<tr>
<td><strong>Persistence</strong></td>
<td>One-off, no persistence OR Rather mid-term than long-term and rather less persistent</td>
<td>Persistent OR Rather long-term than short-term and rather more persistent</td>
<td>Persistent</td>
<td>Persistent</td>
<td>Persistent</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>30% of evaluations 30% only collaboration Behavioural additionality is mostly implicit</td>
<td>15% of the evaluations 50% only collaboration Behavioural additionality is mostly implicit</td>
<td>20% of the evaluations Mostly collaboration and beyond Behavioural additionality is mostly implicit</td>
<td>15% of the evaluations Mostly collaboration and beyond Behavioural additionality is more explicit than others</td>
<td>20% of the evaluations</td>
</tr>
</tbody>
</table>
3.5. Conclusion

This chapter outlined the general characteristics of behavioural additionality evaluations by using the INNO-Appraisal database, which covers the bulk of the national innovation policy evaluations of EU25 conducted within the five years between 2002 and 2007. The most striking results are:

- Input, output and behavioural additionality are mostly used together in evaluations.
- Characteristics of the three types of additionality are somewhat different from the rest of the data while behavioural additionality shows the most distinct characteristics out of these three.
- Behavioural additionality is related to knowledge generation as much as it is to value generation.
- Behavioural additionality evaluations are not significantly method-biased. While qualitative methods are used slightly more, both qualitative and quantitative methods are used together and separately. Furthermore, perceived quality and usefulness difference between these two method sets are minimal (c.f. Georghiou (2007)).
- Behavioural additionality evaluations are not of higher quality and more useful than other evaluations in general.
- Similarly, a text analysis of a number of behavioural additionality evaluations revealed that with some minor adjustments the same confusion about the definition of the concept within the scholarly literature is prevalent in the practice. Furthermore, none of the four different types of understanding of behavioural additionality is dominant in the practice.

These two avenues of qualitative and quantitative analysis together reiterate the conclusion that the concept of behavioural additionality is still vague and not fully understood. This reinforces the conclusion of Chapter 2 that it needs further theoretisation and particularly a new unit of analysis.
Part I

Chapter 4: Behavioural Additionality as a Concept of Innovation Policy-Making
4.1. Introduction

As noted in Chapter 2, the concept of behavioural additionality has been used and understood mainly in the context of evaluation of technology and innovation policies. However, the concept has also been utilised centrally in technology and innovation policy-making discussion itself by a number of scholars.

The additionality framework has been used to compare and contrast the two main competing approaches/paradigms to technology and innovation policy: input and output additionality are considered as the hallmark of the neoclassical (NC) logic whereas behavioural additionality is associated with the evolutionary/structuralist (ES) rationale for technology and innovation policy.

This chapter will discuss the neoclassical and ES approaches only to an extent that they are relevant to the concept of additionality. The core of the discussion is drawn from the literature that directly referred to the concept of additionality due to two reasons. Firstly, physically it would be impossible to comprehensively cover these two substantially large bodies of literatures spanning various policy areas including innovation policy. Secondly, as the aim of this chapter is only to ground the concept of additionality in the policy domain where the concept has been discussed as a critical division point between neoclassical and ES approaches by certain scholars, a limited characterisation drawing mostly from the primary literature would be effectively sufficient.

This chapter follows a natural flow in locating the concepts of additionality in policy rationales. Section 2 will outline the main characteristics of the neoclassical approach and pinpoint input and output additionality. Section 3 will discuss the role of the concept of behavioural additionality within evolutionary/structuralist framework. Section 4 will conclude with an insight as to how to reinforce behavioural additionality if it is to become even more relevant to fundamental policy discussions.

4.2. Input and Output Additionality as Concepts of Neoclassical Approach

The dominant paradigm in economics is neoclassical (NC) economic theory, also known as mainstream theory. This section will first give a brief account of the main tenets of the NC economic theory. As discussed above, the aim of this task is not to provide a comprehensive review; only the characteristics relevant to further discussion will be outlined. A vast majority of studies that embrace an evolutionary point of view starts from a critique of neoclassical economics. Most often, the degree of criticism reaches to a point where neoclassical economics becomes a straw man. This will be avoided in this study: the aim is not to provide a full-fledged
critique but to characterise the main features of neoclassical approach to be able to locate the concept of additionality. Similarly, some of the issues will be presented in a caricature and simple form only to show the dominant line of thinking within the NC approach. There are some studies in the mainstream literature that use approaches different to the picture drawn below, but are more similar to the evolutionary approach in some respects. However, the characterisation below is a representation of the majority.

This section will discuss the implications of the NC theory for the technology and innovation policy. Finally, this will be used to discuss how NC rationale for technology and innovation policy relates to the additionality framework.

4.2.1. Main Features of the Neo-Classical Theory

According to NC theory, economics is “the science which studies human behaviour as a relationship between ends and scarce means which have alternative uses” (Robbins, 1945: 16). This definition appears in all textbooks of economics in a similar form. Lipsey and Carlaw21 (Lipsey and Carlaw, 1998a, 1998b, 2002) identified the following relevant main features of NC economic theory, which are also summarised in Exhibit 11.

Maximising behaviour

NC theory assumes that the default decision criterion for agents is maximisation. Firms try to maximise their profits, while individuals maximise utility and governments maximise social welfare. When considering the economy as a whole, the aim of NC economics is to identify the conditions under which welfare is maximised (welfare economics). Agents maximise explicitly known profit / utility / social welfare functions about which they normally have perfect information. In those circumstances where agents do not have perfect information about their functions or some parameters in these functions or other agents’ functions, which they need to take consideration, they assign probabilities and maximise the expected values. In all cases, all agents are assumed perfectly rational.

This kind of assumption has two further implications. Firstly, for simplicity, NC economic theory assumes agents are homogenous – for instance, there are only a few types of firms and individuals. Furthermore, this leads to the idea that agents that have the same parameters for the same type of function (i.e. two firms that have the same constraints), for example, will act exactly in the same way in all possible areas as they only maximise their functions. Secondly, any

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21 It might be important to note that Richard G. Lipsey is the author of some of the most known textbooks of the science of economics. He has been seen as one of the most prominent figures in the neoclassical mainstream textbook version of economics. However, recently he has turned his attention to evolutionary economics and as it also is discussed in this Chapter, he has become a leading figure in criticising the neoclassical theory and its incapability to inform technology and innovation policy. In fact, as part of this effort, he was awarded the Schumpeter Prize in 2006.
economic problem is one of a maximisation of an objective function subject to a set of constraints. This approach reduces economics to a subject of applied (and in most cases pure) mathematics (Dillmann et al., 1974). This has even been criticised by prominent figures of the mainstream figures of economics such as Krugman who admits the recent global crisis is partly due to the fact that “the economics profession went astray because economists, as a group, mistook beauty, clad in impressive-looking mathematics, for truth”(Krugman, 2009: 36).

Unique equilibrium
NC theory assumes an equilibrium state of economy in which there is ideally perfect competition and perfectly symmetric information amongst agents. The first fundamental theorem of welfare economics states that a competitive equilibrium leads to a Pareto efficient state in which it is not possible make to any agent better off without making another agent worse-off. Similarly, the narrower second fundamental theorem of welfare economics asserts that the welfare maximising equilibrium can only be sustained by perfect competition. Therefore, working markets ensure optimality.

Any change in exogenous constants such as technology and consumer preferences leads to a shift in equilibrium but instantly attained new equilibrium would be a steady point and the change from the first equilibrium to the second would represent the optimal growth path. Some more advanced studies focuses on the process of slower transition, but the logic of moving from an equilibrium to another state is a common characteristic.

Competition
Lipsey and Carlaw (1998a, 1998b, 2002) argue that NC economic theory treats competition not as a process but as an end state. It is a condition for the economy to be Pareto efficient (the first theorem mentioned above), but it is not studied as a dynamic mechanism that creates the welfare maximising equilibrium. Hayek (1980: 94) criticises this stationary view by arguing, “competition is by its nature a dynamic process whose essential characteristics are assumed away by the assumptions underlying static analysis”.

Framework of Analysis
NC economic theory uses ‘comparative statics’ as the framework of analysis. Thanks to the assumption about the possibility of equilibrium and the homogeneity of agents discussed above, an initial equilibrium is analysed against another one by changing a marginal parameter and holding all other parameters constant (i.e. ceteris paribus assumption). Then, the difference between the two equilibria can be associated with the change in the parameter. In the simplest example, the implications of the change in a given technology for a given product on its price and quantity are analysed by comparing the initial equilibrium with new equilibrium where the supply curve shifts.
This framework of analysis was introduced by Pareto and subsequently made the *modus operandi* by Samuelson (1983). It is different from ‘statics’ where the parameters are analysed in a stationary situation. It also differs from ‘dynamics’ where the process of change itself is the focus.

Some of the more advanced studies in the NC approach attempts to explain the process of transition by using sophisticated mathematical techniques. However, this does not qualify them to be considered using the framework of analysis of ‘dynamics’ as their analysis is still restricted to a transition from a stationary equilibrium to another one. Often, most of these studies’ focus is not the process, lags, sequences, periodicities etc. but the conditions under which the new equilibrium is maintained.

**Technology**

For most of its development, technology has only been an exogenous variable for NC economic theory. In most of the models, technology is captured as part of the investment function in which R&D expenditure is exactly the same as any other type of investment except the expected gain is in the form of a probability distribution. Similarly, marginal returns of R&D are assumed to be same as with other kinds of investments. Therefore, technology is not modelled explicitly in most of the NC economic theory. The earliest and subsequently most influential models of growth using NC theory were due to Robert Solow (1957), who introduced ‘technical change’ into the production function (the aggregate relationship between inputs and outputs). However, technical change was thought to be so difficult to measure that the analysis reduced it merely to ‘residual’ (i.e. what could not be explained by the change in capital and labour) (Romer, 2006). Similarly, as knowledge is treated equal to information by not recognising tacit knowledge and firms are homogenous in their capabilities to absorb a technology, it is assumed that any given technology disseminates instantly across an economy22.

Due to the above logic, as Lipsey and Carlaw (1998a, 1998b, 2002) echo clearly, in most of the NC models, technological change is only observable in its results. The structure and process of change, on the other hand, are only a black-box. NC economic theory is not interested in the process, as all of the focus is given to input and output. In other words, NC theory considers the issue of technology from an input/output perspective (Bach and Matt, 2002, 2005). In Robbins’ (1945: 37-38) words (neoclassical) “economists are not interested in technique as such” (Lipsey, 2009).

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22 In recent years, Paul David’s “new economics of Science” has been trying to relax this assumption.
Institutions

NC economic theory does not have any particular emphasis on economic structure and institutions. Although there is a certain avenue in economics that studies institutions and governance, most of the studies on technology does not take institutions and economic structure into their particular focus.

The above is a much abbreviated, simple version of NC theory (appropriate to this context). However, it does explain the fundamental essence of NC theory. Under certain conditions, markets produce an optimal outcome for society’s welfare. Much of advanced economic theory is concerned with identifying these conditions exactly, and in examining where these are not met ‘in the real world’, and what can be done by policymakers to remedy these ‘market failures’ to better reproduce the conditions under which optimality can be searched. This is the fundamental justification for most policies in technology and innovation. This issue will be discussed in the next section.

4.2.2. Rationale for Technology and Innovation Policy in Neo-Classical Theory

There are two sets of main arguments in favour of intervention to technology and innovation markets in NC economic theory. The first and fundamental argument stems from the fact that the end result of innovative activity (knowledge created at the end of an R&D process particularly) is non-rivalrous and non-excludable and therefore it posits public good characteristics. Similarly, innovative activity and its end-result are very risky and indivisible (excessively costly). These, in turn, make the knowledge created not appropriable. Thus, there is risk that the investment to the innovative activity might not be as desired (profitable) as possible for actors to persuade them to invest. On the other hand, as subsequently argued by Griliches (1992), R&D spill-overs create positive market, knowledge and network externalities to such a degree that the social return exceeds the private return. These two, then, ultimately lead to the risk of under-investment as privately optimum level of innovative activity could be less than the socially optimum level (Arrow, 1962; Bach and Matt, 2002; Hall, 2002; Nelson, 1959; Stoneman and Vickers, 1988).

23 In fact, 2009 Nobel Prize for economics awarded for studies in economic governance is a particular example of this.

24 Textbook economics classify goods according to two criteria. First, rivalry criteria asserts that a good can be either rivalrous so that its consumption by a consumer physically prevents consumption by another consumer at the same time or it can be non-rivalrous so that it can be consumed by different consumers at the same time. Secondly, a good is classified as excludable if its use can be prevented from the consumers who have not paid for and non-excludable otherwise. In the two-by-two matrix of rivalry and excludability, public goods are non-rivalrous and non-excludable.
Within the second set of auxiliary arguments, Hall (2002) reminds us of the famous ‘credit gap problem’ which asserts that because of information asymmetries and moral hazards under uncertainty stemming from the peculiar characteristics of innovation, financial markets fail to fund innovation investments. Secondly, there might be some certain ‘strategic’ areas such as defence in which R&D needs to be supported by the government. Finally, as standard setting might be the duty of government in some instances, some markets that might fail by locking in inferior technologies might need policy intervention to maximise social welfare.

Within this backdrop, the role of the government is to i) reduce uncertainty, ii) substitute failing markets by sharing risks and costs and iii) devise ways to overcome inappropriability. Therefore, the government should devise and implement policies to attain the ‘second best’ by reinstating the social optimum as closely as possible. This, in turn, needs to be done by helping the failing markets which impedes the ‘first best’ Pareto optimum. However, this remit is only limited to the areas where markets fail, to avoid creating ‘government failures’ and remedies should be in the form of quasi-markets (Bach and Matt, 2002, 2005; Lipsey, 2002; Lipsey and Carlaw, 1998a, 1998b, 2002; Lipsey et al., 2005).

Lipsey and Lancaster (1956) argued in their famous article that the first best is attained not in a particular and limited market but in general equilibrium. Therefore, any distortion in an individual market cannot be remedied in this market itself, the second best can only be achieved by changing a set of parameters in a set of markets. This argument has long been debated and criticised consequently by other NC scholars as an excuse for a comprehensive interventionism (Lipsey, 2007).

### 4.2.3. Evaluation Criteria for Technology and Innovation Policy in Neo-Classical Theory

As the government’s intervention remit is to reinstate the first best, any policy should be an improvement compared to the initial market failure case. For example, if the policy is built on the fundamental neoclassical argument that the firms invest less than they are supposed to in order to reach the socially optimum welfare, then government action needs to ensure that firms invest more than what they would have invested without any intervention. Similarly, if the aim is to increase outputs, then government action should lead to more outputs. Therefore, fundamentally a policy is successful only if it creates input and/or output additionality. If a government action designed to address market failures does not create more inputs and/or outputs that would not have been created without it (e.g. input and/or output additionality), then it is unsuccessful. This is called ‘narrow test of additionality’ by Lipsey and Carlaw (1998a, 1998b, 2002).
As Lipsey and Carlaw (1998a, 1998b, 2002) point out, some NC scholars such as Usher (1994) carry the condition even further by requiring the following extreme input additionality conditions, ‘ideal test of additionality’\(^{25}\) in their terminology, to assess a policy as successful:

- Government’s contribution must not be more than exactly the same amount required to persuade the firm to invest the required amount.
- The particular project supported must be the most cost efficient way to increase private R&D investment.
- Total cost of intervention that includes transaction costs, dead-weights and other leakages should not exceed total value of benefits.

\(^{25}\) incrementality in Canadian terminology
Exhibit 11: Neoclassical Approach and its Rationale

**General Features**
- All agents aim to maximise their objectives
- All agents act rationally
- Agents are homogenous
- There is a unique equilibrium
- Framework of analysis: comparative statics
- Fundamental theorems of welfare economics hold
- Competition is not a process but an end state
- No particular emphasis on institutions

**Approach to Technology**
- Technology is exogenous
- Technological change is only observable in results
- Linear model of innovation simplified by product function approach

**Rationale for Policy**
- Market failure might bring sub-optimal investment in R&D
- Credit gap problem
- Strategic industries
- Avoiding lock-ins to inferior technologies

**Evaluation Criteria**
- Input and output additionality as the hallmark of policy
4.3. Behavioural Additionality as a Concept of Evolutionary / Structuralist Approach

The evolutionary / structuralist (ES) approach which is a constellation of a number of different line of thoughts contrast with the neoclassical approach in a number of ways (Bach and Matt, 2002, 2005; Lipsey, 2002; Lipsey and Carlaw, 1998a, 1998b, 2002; Lipsey et al., 2005; Metcalfe and Georgiou, 1998). The loose set of ideas under this category is vaguer than the neo-classical approach that has the advantage of being mainstream and ‘textbook’ based. However, it would be safe to draw a boundary following the lines of Nelson and Winter (1982).

As with Section 4.2, this section will provide a brief overview of the evolutionary / structuralist approach. This will be more concise and less structured than that of Section 4.2 because of the above-mentioned reason. Furthermore, similar to the last section, the overview will be limited to the discussion relevant to the purpose and comprehensiveness will not be sought. Moreover, in spite of the fact that there will be a relevant discussion of the ES approach here, due to the shell design of the thesis as explained in Chapter 1, evolutionary theory will be thoroughly reviewed in a separate chapter – Chapter 6. The natural flow of rationale and evaluation criteria for technology and innovation policy within ES will follow in the subsequent sub-sections of this section. The whole section is summarised in Exhibit 12.

There are two reasons why the term ‘evolutionary’ is applied to evolutionary economic theory. In particular, whereas NC theory assumes homogeneity in many respects (e.g. firms, households, production, etc.), evolutionary theory concentrates on the differences between agents and their response to often-similar stimuli. This is necessary in order to explain ‘innovation’ or ‘novelty’ as well as the obvious differences observed in the ‘real world’. Secondly, the focus in evolutionary theory is on the process or the dynamics, which produce change over time.

4.3.1. Main Features of Evolutionary / Structuralist Approach

Almost all of the studies within the ES stream have put a special emphasis on knowledge and its creation. Accepting the tacit nature of knowledge (unlike the NC approach which treats knowledge same as with information), the ES approach is aware of the fact that the central problem in economics is knowledge creation and exploitation.

Because knowledge is tacit, learning is much more complicated in the eye of the ES approach than its NC counterpart. Agents are not homogenous and there is no single representative agent through which calculations can be done. Firms, in particular, have different capabilities to create, absorb, exploit and appropriate knowledge. These activities do not only require physical capital, intangible assets are also required to build up capability. Knowledge is stored in the organisational
routines of the firm through which firms ensure stability and are also able to innovate and change\textsuperscript{26}. Therefore, cognitive capacities of the agents which are essential to create and use organisational routines are particularly important \textsc{(Nelson and Winter, 1982)}.

Following Simonian tradition \textsc{(Simon, 1982)}, the ES approach accepts that agents have bounded rationality. Information is scarce (due to high degree of uncertainty) and also asymmetric and agents have different cognitive capacities to process it. Therefore, the ES approach does not assume that agents act rationally. Another implication is that agents do not maximise. The ES approach does not assume the existence of an optimum and thus agents do not and cannot maximise. This leads to the collapse of general and partial equilibrium, whole Walrasian space and the fundamental theorems of welfare economics. Equilibrium is incompatible with the restless nature of capitalism and indeed very rare \textsc{(Metcalfe, 2005; Metcalfe and Georghiou, 1998)}.

Unlike the NC approach, the ES framework does not assume agents as homogenous. For the ES framework, agents are unique because of the knowledge dynamics discussed above. These, in turn, determine how firms behave in different conditions and that is why firms in the same industry with similar size and characteristics do not behave in the same way. In fact, the ES approach gives importance to diversity and accepts it as a condition for an economy to succeed.

Due to knowledge dynamics, economic reality and innovation in particular are collective. All economic activity is done together by actors; they are not isolated as the NC approach perceives. Similarly, they are path-dependant. Because firms are unique, whatever they do at one point in time affects their future behaviour and therefore renders them even more different than each other. Similarly, path-dependency is applicable to structures and institutions and therefore initial conditions are very decisive. Economic activity including innovation is also context dependent.

For the ES approach, innovation is a world of systems. Different kinds of actors work together to create and exploit knowledge and a problem in one part would influence the whole system. This has implications at many levels including sectors, regions, nations, etc. \textsc{(Nelson, 1993)}.

The issues considered as problems by the NC approach such as asymmetric information, moral hazards, and adverse selection are indeed sources of innovation and therefore variation for the ES approach. In fact, these characteristics are the very reasons why the economy grows \textsc{(Metcalfe, 2005; Metcalfe and Georghiou, 1998)}.

Unlike NC approach that uses ‘comparative statics’ as the framework of analysis, the ES approach utilises ‘dynamics’\textsuperscript{27}. Comparative statics is suitable to the purpose of the NC approach which is

\textsuperscript{26} Next Chapter provides a comprehensive survey of organisational routines.

\textsuperscript{27} See Chapter 6 for more detailed discussion.
mainly concerned with the ‘quantity questions’ (e.g. how much has something changed, what was the direction of the change? etc.). However, for the ‘quality questions’ of ES approach (e.g. why has something changed, by which mechanism has it changed, what is the pattern of change? etc.) dynamics should be employed. Dynamics often involves more than two observations and it does not involve ‘ceteris paribus’ assumption.

### 4.3.2. Rationale for Technology and Innovation Policy in Evolutionary / Structuralist Approach

As noted above, the ES approach does not recognise market failures represented by deviations from ‘optimal’ situation. The main economic issue here is facilitating learning so that agents increase their cognitive capabilities. Bach and Matt (2002, 2005) identified the following problems that the ES approach is concerned with to some extent:

- **Exploration/exploitation failures**: Agents might misallocate their cognitive capacity to some inferior activities at the expense of other superior ones.
- **Selection failures**: Physical and social entities (firms, technologies or institutions, etc.) might be inefficiently selected. For example, some potentially superior technologies might be eliminated very soon or inferior ones might be locked in.
- **System failures**: Agents might be different in their cognitive capacities and activities; they might be mis-coordinated, incompatible and could not cooperate because of rigid facilitating structures. They might lack appropriate facilitating institutions and the co-evolution of institutions and technologies might be incompatible.
- **Knowledge processing failures**: Codification problems, problems associated with absorptive capacity, agents’ inability to bridge internal and external knowledge might lead to failures.

Unlike the NC approach, the ES approach accepts government as part of the system. In the NC world, the government is not part of the natural components of a running market and acts only if it is deemed absolutely necessary in case the forces of the market fail. However, for ES approach, innovation is a matter of systems at various levels and government is a part of the game, either actively or inactively.

The chaotic environment of unpredictabilities and incomplete information coupled with the existence of complex innovation systems dictate that the rationale, influence mechanisms and consequences of policies are subject to change very dramatically and rapidly. Therefore, policymakers should be adaptive to these changes and policies should not be stationary but dynamic (Metcalfe, 2005; Metcalfe and Georghiou, 1998).
4.3.3. Evaluation Criteria for Technology and Innovation Policy in the Evolutionary / Structuralist Approach

The main issue of policy for the ES approach is to increase cognitive capacities of agents and/or to resolve exploration / exploitation, selection, system, and knowledge processing failures. Therefore, input and output additionality are not the whole story in the ES approach. On one hand, a policy that creates input / output additionality might be unsuccessful to address various failures and cognitive capacities. On the other hand, another policy that does not create any input/output additionality might be addressing these issues. Therefore, the input / output (additionality) paradigm is not sufficient to assess a policy.

The ES approach does not see policy as a one-off venture. On the contrary, it is part of an evolutionary process which is inherently dynamic and spans a longer time-frame. Therefore, impacts that are created in agents through the policy should be persistent – they should not disappear quickly. All these effects should influence the evolution of the agents, a group of agents and finally the economy. Similarly, these effects are not considered isolated within particular agents and recognised as part of a complex system.

Within the above context, for the ES approach, a policy is only successful if it increases the cognitive capacity of agents, thus it involves persistent influences. One off non-persistent impacts are not sufficient for successful policy. Therefore, the criterion is an increase in cognitive capacity of agents in such a fashion that it would not have been the case without government involvement and also to such an extent that it contributes towards the resolution of various non-market failures. Bach and Matt (2002, 2005) call this ‘cognitive capacity additionality’ while Georghiou (2004, 2007; Georghiou and Clarysse, 2006) calls it “behavioural additionality”. This logic renders behavioural additionality as the hallmark of ES rationale for technology and innovation policy – a policy is successful if it creates behavioural additionality and unsuccessful if it does not.

28 The reason that Bach and Matt (2002, 2005) needed to invent yet another concept of additionality is that, at that point behavioural additionality was defined narrower than it is defined in some sources thereafter. However, some of the current conceptions of behavioural additionality include the idea of cognitive capacity additionality (See Chapter 2 and 3 for different conceptions of behavioural additionality). Similarly, the very aim of this thesis is to broaden the concept of behavioural additionality to fit better to this framework. Therefore, cognitive capacity additionality will be considered within behavioural additionality throughout the thesis.
# Exhibit 12: Evolutionary/Structuralist Approach and its Rationale

## General Features
- Equilibrium is uncommon
- Framework of analysis: dynamics
- Bounded rationality
- Learning is a key issue
- Non-linear innovation model

## Approach to Technology
- Knowledge creation is the central issue
- Knowledge creation is path-dependent, context sensitive and collective.
- Systems of innovation thinking

## Rationale for Policy
- System and learning failures need government action
- Experimentation should be supported to ensure diversity
- Government is a facilitating actor
- Government creates and supports institutions
- Adaptive policy-making

## Evaluation Criteria
- Behavioural additionality is the hallmark of policy
4.4. Conclusion and Synthesis: Additionality and Different Rationales for Technology and Innovation Policy

The NC approach to technology and innovation policy requires input and output additionality as a sufficient condition for the very aim of the policy, so market failures can only be restored by creating input and output additionality. That is why any programme evaluation conducted within a NC conceptual framework uses them explicitly or implicitly as discussed in Chapter 2 and 3.

In a similar vein, behavioural additionality is the hallmark of technology and innovation policy from the ES angle. Any policy action that does not change the persistent behaviour of agents by improving cognitive capacities or creating institutions ultimately would be unsuccessful and/or irrelevant to the ES approach.

This backdrop assigns a broader remit for behavioural additionality. If behavioural additionality is to achieve its objectives, then it has to be more compatible with evolutionary approach. This has two implications. Firstly, as it is discussed in previous chapters, the current evaluation conception and practice of behavioural additionality use comparative statics as the framework of analysis. I have already discussed in Chapter 2 and 3 that the current understanding of behavioural additionality criticises the input / output framework by treating the firm as a black-box but they treat what is inside the black-box (behaviour) as smaller black-boxes. For example, behavioural additionality in the context of collaboration behaviour is often measured as the change in the resources for collaboration by government intervention (input of collaboration) or the number of firms that the firm collaborates with as it is supported by government (output of collaboration). This measurement employs a comparative static framework of analysis in which input of collaboration when the firm was not supported (as established by previous measurement or control groups) is compared with the input of collaboration when the firm is supported (as established by a recent measurement) by holding all other things constant. Thanks to ceteris paribus assumption, the change is the difference between these two static points; it can be associated with the government intervention, and hence behavioural additionality can be calculated. This kind of a view that employs comparative statics as the framework of analysis not only limits the use of full potential of the concept but also hinders its compatibility within evolutionary thinking. As I discussed above, the ES view to innovation and technology policy-making requires a dynamic framework of analysis in which the focus of analysis is not the end-result of the change but the process of change. Therefore, it is concluded that behavioural additionality must embrace a dynamic framework of analysis.

Secondly, the proposed unit of analysis for behavioural additionality, organisational routines, requires the evolutionary framework of analysis, as these two are complementary to each other.
Chapter 2 already proposed that organisational routines are suitable candidates for being unit of analysis for behavioural additionality. In fact, Chapter 5 will further discuss this issue. Therefore, this adjustment requires behavioural additionality to be analysed within the evolutionary framework of analysis, as organisational routines are the core component of understanding firm behaviour in the ES approach. This second point, in turn, reinforces the first conclusion that the conceptual background of behavioural additionality requires it to be analysed with an evolutionary framework of analysis.
Part I

Chapter 5: The Concept of Organisational Routines as a Unit of Analysis
5.1. Introduction

The originative work of Nelson and Winter (1982) utilised the concept of organisational routines as a unit of analysis in their evolutionary explanation of economic change. This acclaimed research programme has been the iconoclast of the black-box logic of orthodox/mainstream/neo-classical economics that considers organisations as perfectly rational and symmetrically informed agents, who in the particular case of firms, are programmed to maximise their profits. For Nelson and Winter (1982), there should be a better explanation for firm behaviour rather than the naive assumption that they are fundamentally homogenous in terms of their goals, orientations and accomplishments. One of their main quests was therefore to understand the dynamics of this behaviour and thus its stability and change. Nelson and Winter’s (1982) idea was to introduce organisational routines as the unit of analysis that shapes the firm behaviour and this radical idea has found powerful allies since then.

Along with the Carnigie School tradition (March and Simon (1953) and Cyert and March (1964)), on which Nelson and Winter (1982) built their understanding of organisational behaviour, organisational routines have served as a strong alternative as a unit of analysis of organisations especially in the evolutionary economics and strategic management literatures.

According to Becker (2008b: 3), “to understand routines is to understand the organisation” and organisational routines can be “very attractive” for different social science disciplines since (i) it is “the most micro-level” amongst the family of concepts of institutions, norms, conventions, etc., (ii) it is the link between the individual and organisational levels and finally (iii) it can be considered as a Weberian “concept of order”.

Expectedly, organisational routines can explain stability in an organisation. They function as the source of truce, coordination and control, reduced uncertainty and knowledge storage (Becker, 2004). Less obviously, organisational routines guide learning and they are the main source of change within an organisation (Becker, 2004; Dosi et al., 2008; Greve, 2008; Miner et al., 2008; Nelson and Winter, 1982; Ventresca and Kaghan, 2008).

Organisational routines can provide an answer to the need for a sounder unit of analysis for the concept of behavioural additionality as established in Chapter 2. This chapter, therefore, explores the concept of organisational routines as a unit of analysis to be used in the re-theoretisation of behavioural additionality. It starts by investigating the definitions, features and functions of the concept in the next section. This is followed by two parts discussing the functions of routines as a source of stability and change. Finally, in Section 5.5, the operationalisation of the concept is outlined.

29 Some parts of this chapter appear in Gok (2010).
As the aim of this chapter is to provide a backdrop for the re-theoretisation of behavioural additionality by using organisational routines as a unit of analysis, this chapter is designed to provide a quick guided tour of that landscape. As the main aim is to discuss the basics of organisational routines and go into detail wherever applicable, it can neither be claimed that this chapter is an original contribution to the organisational routines literature as such nor does it cover all of the issues in a level of detail as it has been discussed in its original domain.

**5.2. The Nature of Organisational Routines**

In this section, I will explore the basics of the concept of organisational routines. To do this, first I will summarise the genesis of the concept. Then, the common features across the literature will be outlined before explaining different definitions of the concept. This will be followed by the functions of organisational routines.

**5.2.1. Genesis of Organisational Routines**

Becker (2001) reports that there is no source in the literature investigating the history of organisational routines. However, the allied concepts of behaviour such as habits and customs have been the subject of scientific inquiry since the Ancient Greeks. These concepts played an especially important role in English utilitarianism and German idealism as well as in the writings of Mill, Hegel and Malthus in the 18th and 19th century. In the 20th century, these were in the theories of Durkheim, Weber, James, Veblen and Commons. In 1920s, the concepts of ‘habitual behavioural dispositions’ were in their golden age thanks to the dominance of the institutional school in various social science disciplines. However, criticism towards Darwinism, rising positivism and anti-behavioural approaches and finally the Great Depression contributed to these concepts’ rapid leaving the stage (Becker, 2001).

The beginning of the 1940s witnessed a sudden comeback of behavioural analysis and the creation of the proto conception of routines. This wave was lead by Simon (1948), Penrose (1959), March and Simon (1953) and Cyert and March (1964). Finally, the term can traced in Winter’s (1964) early writings (Becker, 2001).

The real promoter of the concept came in 1982 with the famous book by Nelson and Winter. Among other radical ideas, the book offered an evolutionary explanation to the economic process in which organisational routines played a central role as analogous to the role of genes in biological evolution. It has attracted an unprecedented attention from a wide spectrum of social scientists, particularly from economists and sociologists.
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Since then there have been times of increased and decreased attention to the concept. The Santa Fe Workshop was exclusively gathered to discuss the concept (Cohen et al., 1996), a series of conferences were organised by Markus C. Becker and Natalie Lazaric of (then) BETA and finally the publication of the Handbook of Organisational Routines (Becker, 2008a) marked another important point in the history of the concept.

### 5.2.2. Definitional Issues of Organisational Routines

Despite the consensus on the importance of organisational routines and the concept’s potential as a unit of analysis, the definition and scope of the concept still remain vague. There has been an extensive debate on the nature of routines in the literature and the ambiguous and conflicting definitions of the concept have resulted in misunderstandings, which have contributed to underutilisation of the concept (Becker, 2004, 2005a, 2008b; Hodgson, 2008).

These differences led to three main broad categories of approaches (Becker, 2004, 2008b; Hodgson, 2008). Before exploring these differences, two of the common features almost everybody in the literature agrees should be discussed.

#### 5.2.2.1. The Collective Nature of Organisational Routines

Routine is a collective concept as it involves more than one individual within an organisation (Becker, 2001, 2004, 2005a; Dosi et al., 2002; Hodgson, 2008; Nelson and Winter, 1982). This implies that a routine can be distributed (Becker, 2004).

The corresponding term at the individual level is habit for most scholars (Becker, 2004, 2005a; Becker and Zirpoli, 2008a; Cohen et al., 1996; Hodgson, 2003, 2008; Hodgson and Knudsen, 2004; Knudsen, 2008; Pentland and Feldman, 2005). However, for some other scholars, it is considered to be a skill. Furthermore, skills are the “building blocks” of organisational routines, but this does not mean that organisational routines are merely the sum of skills – the interaction and organisational context are equally important (Dosi et al., 2002: 4; Nelson and Winter, 1982).

According to Nelson and Winter (1982), one needs to understand individual skills to be able to better comprehend organisational routines as (i) individuals perform their skills within an organisation and these form the basis of routines and (ii) individual skills are the main factors to save a routine from decay. Similarly, Hodgson’s (2008: 15) reasons for the study of habits for understanding routines are (i) the fact that “routines operate through the triggering” and (ii) “routines are the organisational analogue” of habits.

#### 5.2.2.2. Organisational Routines as Recurrent and Persistent Patterns

Another feature of organisational routines that lays the grounds for a common agreement is that routines are patterns or regularities (Becker, 2001, 2004; Cohen, 1991; Nelson and Winter,
Furthermore, organisational routines are recurrent. They are “units or ‘chunks’ of organized activity with a repetitive character” (Dosi et al., 2002: 4). However defined they are, they need to happen more than once: anything that happens just once cannot be considered as a routine. Connectedly, organisational routines are persistent. For it to be considered as an organisational routine, the recurrence should span a considerable time frame. Anything that recurs in a very limited period is not an organisational routine (Becker, 2004).

There are broadly four groups of approaches to define the concept. Organisational routines are defined as i) regular behaviour patterns, ii) behavioural propensities, iii) rules and procedures by different scholars. Finally, Pentland and Feldman’s (2005, 2008) definition, which considers organisational routines as generative systems, is a synthesis of these three approaches. These four definition categories are discussed below.

5.2.2.3. Organisational Routines as Regular Behaviour Patterns

Organisational routines are defined as regular behaviour patterns by some scholars. A pattern should be enacted to be considered as a routine (Becker, 2001, 2008b; Dosi et al., 2002; Winter, 1964).

Nelson and Winter’s (1982: 97) conception can also be considered in this category although there are contradictory passages of the definition of the term which could qualify it in the following definition categories as well. However, the clearest definition of the concept in there reads as “a repetitive pattern of activity in an entire organisation”.

Becker (2004) elaborates the definition as ‘recurrent interaction patterns’ by arguing that the word ‘interaction’ suits the purpose better since not only it does reflect the collective characteristic but it is also broader than ‘behaviour’ which is a response to a stimulus.

5.2.2.4. Organisational Routines as Behavioural Propensities

A more recent definition by Hodgson and his colleague Knudsen considers organisational routines as “organisational dispositions to energise conditional patterns of behaviour within an organised group of individuals, involving sequential responses to cues” (Hodgson, 2008: 21). In other words, organisational routines are ‘stored behavioural capacities or capabilities’ or ‘behavioural dispositions / propensities’ (Hodgson, 2003, 2008; Hodgson and Knudsen, 2004).

Hodgson (2008) calls attention to the above-mentioned contradictory definition of Nelson and Winter (1982: 97), which sees routines both as behavioural dispositions analogous to ‘genes’ of biology or ‘programmes’ of computer science and the actual enacted patterns of behaviour. He argues that defining routines as patterns of actual behaviour defines them in terms of what they do and this would be misleading. Furthermore, he claims that potential is more fundamental than
actual. Finally, he points out that if the gene analogy is to be employed, it should be noted that genes in biology are not actualities but potentialities; therefore, what is analogous to them, routines could not be behaviour as such.

### 5.2.2.5. Organisational Routines are Rules and Procedures

A third definition of organisational routines, the Carnegie one, takes routines as ‘rules’, ‘standard operating procedures’, if-then like statements. Therefore, they are cognitive regularities/patterns (Becker, 2004; Becker et al., 2005; Cohen, 1991; Cyert and March, 1964; March and Simon, 1953).

### 5.2.2.6. Organisational Routines as Generative Systems

Pentland and Feldman (2005: 794-5; 2008: 286) combine all of these definitions together, i.e. organisational routines are both behavioural and cognitive patterns/regularities as well as there is room to dispositions. To be precise, they are “continuously emerging systems with internal structures and dynamics”. Therefore, they are “generative systems that can produce a wide variety of performances depending on the circumstances”.

The ostensive aspect as depicted in Exhibit 13, refers to the cognitive and abstract dimension “that enable participants to guide, account for and refer to specific performances of a routine”. Therefore, it is ‘narrative’ or ‘script’. They are also what Hodgson calls as dispositions. The ostensive part tends to be very detailed and fine-tuned. Furthermore, because it is abstract and also detailed, individuals’ perceptions can vary to a greater extent for the ostensive aspect of a routine. Therefore, there can be many different versions of the ostensive aspect (Pentland and Feldman, 2005: 795-6).

The performative aspect, on the other hand, refers to the enactment of the ostensive part by a particular actor in a particular time and space. Therefore, they are “effortful accomplishments”.

The performative side can vary as it may incorporate the personal touch in the form of improvisation (Pentland and Feldman, 2005: 795-6).

Finally, in Pentland and Feldman’s (2005, 2008) conception artefacts are ‘physical manifestations’. They can be abstract - rules, regulations, standard operating procedures are artefacts. However, they can be physical as well – machinery, computers, and even the physical layout are also artefacts.

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30 Taken from Pentland and Feldman (Pentland and Feldman, 2005: 795-6; 2008: 287)
31 Becker (2004) reports that there is a disagreement on whether organisational routines are ‘effortful’ or ‘mindless’ accomplishments. Interestingly, the studies arguing the former are empirical while the latter ones are associated with theoretical papers.
Pentland and Feldman (2005) warn that rules and operating procedures are not the performative aspect of an organisational routine as variations due to contextual differences, there is a difference between them and performance of routines. Neither are they the ostensive aspect because of the distributed nature of this aspect. However, rules and operating procedures can indicate the ostensive aspect.

The Pentland-Feldman definition of routines seems to be the most sophisticated and comprehensive one. Yet, it is the most applicable definition as the aspects are well defined and unlike the other definitions, there is little room to intuition and ambiguity. Furthermore, it is inclusive; so the existing literature, especially empirical studies, can be easily utilised in the research that embraces this definition. For all these reasons, throughout the thesis, unless otherwise stated, the Pentland-Feldman definition will be employed for organisational routines.

5.2.2.7. Characteristics of Organisational Routines

There are four further important characteristics of organisational routines that could shed light on the purpose of this chapter.

First, organisational routines are processual. That is why they are capable of explaining both the change and stability. Becker (2004) cites many empirical and theoretical studies that look into various aspects of the processual nature such as the speed of decay of routines, the speed of executing routines, the speed of changing their contents, the speed of change between them, etc.

Second, organisational routines are context dependant (Becker, 2004; Cohen et al., 1996; Ventresca and Kaghan, 2008). They are not black-boxes but “rather ongoing social
accomplishments that are embedded in broader and more persistent patterns of activity” (Ventresca and Kaghan, 2008: 53). Similarly, as discussed above they are linked with ‘artefacts’. Becker (2004) reports three kinds of specificity: (i) routines are historical specific as the context is different in different time frames, (ii) they are local specific because they are created by learning processes and cultural differences are important (iii) and finally they are relation specific. For all these reasons: routines, in most cases, are not easily transferable and there is no universal best practice – there is no single made recipe. Rather routines are internalised through learning and therefore local best solutions exist.

Third, routines are path-dependant (Becker, 2001, 2004; Nelson and Winter, 1982) i.e. the state of routine in time t+1 is strongly linked with that of at time t. According to Cohen et al. (1996), the incremental change is due to this characteristic of the routines. As Becker (2004) points out, one of the most famous examples of this is called ‘competency trap’. Levitt and March (1988) argue that because routines are path-dependant, organisations transform the routines they use most and because of the increased success through this transformation, they are used even more. Therefore, organisations specialise in the use of some particular routines. Although sometimes these specialised routines are inferior to alternatives in terms of potential performance, organisations fall into a ‘competency trap’ and continue to employ them.

Finally, Becker (2004) reports that there are two mechanisms through which routines are triggered: routines are triggered by the actors who perform them and by external other cues such as other routines.

5.3. Organisational Routines as a Source of Stability

Clearly, routines are source of stability in organisations. There are at least three dimensions of the stability provided by routines.

Firstly, they provide coordination and control (Nelson and Winter, 1982). According to Becker (2004: 654), this coordination and control power of routines are due to several reasons including “their capacity to support a high level of simultaneity”, “regularity, unity and systematicity to practices” provided by them and their feature of being a catalogue of actions for the agents. This effect of organisational routines has been subject to many empirical studies.

Secondly, routines function as truce in organisations. This is something discussed extensively in Nelson and Winter’s (1982) book. According to them, apart from the other characteristics and effects of routines that are related to the cognition (i.e. to form an answer to the questions ‘what is to do and how?’), routines have a motivational aspect (which answers the question ‘what is required to do?’). As very neatly summarised by Becker (2004), Nelson and Winter (1982: 110)
argue that the control system used by supervisors (rule enforcement) is not the only source of routine operation in an organisation, as the truce established by the routines is equally important. Therefore, it prevents agents in an organisation from being surprised by each other’s behaviour, which are in a way ‘de facto contracts’. "In short, routine operation involves a comprehensive truce in intra-organisational conflict" (Nelson and Winter, 1982: 110).

Organisational routines also reduce uncertainty, which according to Becker and Knudsen (2005), would increase predictability in the face of many unknowns. They are also useful against pervasive uncertainty where both the possible outcomes and their probabilities are not known (as opposed to uncertainty where the decision maker has at least the information of the potential outcomes), since the constrained behaviour because of routinisation provides alternatives.

The Carnigie School argues that change is associated with performance feedback and as long as the performance of a particular routine is not lower than the aspiration level, it is not changed and thus provides a stability (Cyert and March, 1964; Greve, 2008; March and Simon, 1953). This is linked with change as well and is discussed in more detail in the next section. Similarly, Becker (2004) points out the cost argument claiming that changing the way of accomplishing a particular task involves certain costs and therefore, routines tend to provide stability. According to him, routines provide a baseline that the organisation can compare the change against. Therefore, in a way stability is an important condition of learning and change.

5.4. Organisational Routines as a Source of Change and Learning

There are four effects that provide a basis for organisational routines being a source of change. First, as established very well by the Carnigie tradition, agents are rationally bounded and the cognitive powers of organisations are limited (Cyert and March, 1964; Greve, 2008; March and Simon, 1953). Furthermore, because routines provide stability mainly by reducing uncertainty, the limited cognitive capacity can be used for other purposes, for example, for learning and change.

Secondly, it is well established in the literature that routines store knowledge by acting as organisational memory (Nelson and Winter, 1982). In particular, tacit knowledge that cannot be stored in artefacts are kept in routines (Becker, 2004). According to Dosi et al. (2002), routines are the building block of capabilities (although not exclusively) and sometimes they may well be the capabilities themselves. Similarly, for Nelson and Winter (1982), routines are the repositories of capabilities.

Becker et al. (2005: 776) claim that because only organisational routines pose a real explanation for the nature of real change at the organisational level, they are essential to study the change.
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This is due to the fact that (i) endogenous change is mostly in the form of performance variation of routines as reactions to variations in input signals (which is fundamentally the “backdrop for a definition of innovation”), (ii) endogenous change itself is guided by specific routines (for example R&D routines or new product development routines), (iii) the impact of endogenous change is created by the creation of a routine in an organisation.

Thirdly, because routines are repositories of capabilities, they form a framework for change in an organisation. This aspect is discussed in more detail later in this section.

Fourthly, as routines are path-dependent, they provide a roadmap for understanding learning and change. If the change is incremental, it will be guided by change in the existing routines and therefore existing routines play an important role to study the change. If the change is radical, one can derive important lessons by reading the ‘breaking points’ or raptures.

5.4.1. Organisational Routines and the Performance Feedback Theory

According to Greve’s (2008) summary of the Carnegie performance feedback theory, three search processes that lead to change in routines are (i) problemistic search in response to a problem, (ii) slack search as a result of having slack resources and (iii) institutionalized search by purpose-established units. Performance Feedback Theory asserts that rationally bounded decision-makers set out an aspiration level for an organisational unit on the basis of either past performances, performances of a comparable unit or through structured aspiration-setting mechanisms. If the actual performance is lower than the aspiration level set out, it means that there is a problem, which initiates a search process that is guided by the existing routines. The search can also start as a result of the extra resources devoted for this. Decision makers, then, evaluate the solutions created by these problemistic and slack search processes to understand whether the change involves risks and whether it fits the broader constraints. Finally, the decision is made in light of the risk awareness of the decision maker. Of course, if there would be a change it would involve a change in routines.

According to Cyert and March (1964), aspiration level is linked with past aspiration level, performance and aspiration level of comparables. The following formula shows this relationship:

\[ L_t = (1 - \beta_h - \beta_s)L_{t-1} + \beta_h P_{t-1} + \beta_h L_{st} \]

where \( L_t \) is aspiration level, \( L_{st} \) is peer-group aspiration level, \( P_{t-1} \) is previous performance, \( \beta_h \) and \( \beta_s \) are co-efficients.

Greve (2008) cites Knott and McKelvey (1999) who found that organisations leaving a franchise system, thereby eliminating a layer for performance feedback and goal setting experienced
decrease in reliability of existing routines, quantity of the creation of routines and the overall performance. Furthermore, Cardinal (2001) argues that implementing input and output performance feedback controls have a positive effect on radical and incremental innovation and behaviour controls only have an effect on radical innovation. Greve (2008) argues that this proves the fact that performance feedback controls have an effect on both creation of new routines and transformation of existing ones. Finally, he argues that the difference between the aspiration level and the actual performance is positively related with the extent of the change.

5.4.2. Organisational Routines and Learning

The final issue that will be discussed in this section is organisational routines’ relation to learning. Organisational routines are the carriers of organisational memory; some of the various tasks performed in an organisation at time t tend to form a routine at time t+1. This could be consciously or unconsciously (Miner et al., 2008).

Miner et al. (2008) unfold the dynamics of the change in routines through performance gaps explained above and thus shed light on the process of learning through change in routines. To do this, they employ a variation-selection-retention (VSR) framework: a portfolio of routines at time t is varied, selected and retained and therefore transformed into another portfolio at time t+1. This is the full learning cycle. These VSR processes can be either pre-planned or emergent and can either be initiated by internal or external sources. These processes are discussed in Table 9.

Table 9: Routines and Organisational Learning in Miner et al. (2008)

<table>
<thead>
<tr>
<th>Variation</th>
<th>Selection</th>
<th>Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>From Internal Sources and Pre-planned</strong></td>
<td>Conscious and purposeful experimentation creates variation in routines</td>
<td>Routines generating performance above aspiration level are selected. Routines generating performance below aspiration level are abandoned.</td>
</tr>
<tr>
<td><strong>From External Sources and Pre-planned</strong></td>
<td>Adaption of new technology varies routines. Similarly, a routine can be varied by a focal organisation (e.g. by business schools) Laws and regulations transforms routines</td>
<td>Market mechanisms provide a powerful external selection.</td>
</tr>
<tr>
<td><strong>From Internal Sources and Emergent</strong></td>
<td>Through improvisation and bricolage</td>
<td>Internal resource allocation rules In-firm competition Visibility of routines play an important role</td>
</tr>
<tr>
<td><strong>From External Sources and Emergent</strong></td>
<td>By the transfer of key staff Through social networks</td>
<td>Technological lock-in Social movements</td>
</tr>
</tbody>
</table>
5.5. Operationalisation of Organisational Routines

It is not always very easy to study routines. According to Becker et al. (2005) this is due to three reasons: (i) because routines have both technological and social aspects and they are hard to isolate, (ii) similarly cognitive and motivational dimensions of routines are entangled (iii) and finally ostensive/abstract and performative/concrete levels of observation make things complicated.

The first problem here is to decide whether to study routines as black-boxes or to zoom into their dynamics. The first option has its own advantages: it is more practical and one can examine the inputs and outputs of the measure without having to examine what is in between. However, it may be too simplistic and inaccurate. It is useful when the study is about the description, prediction and comparison of the routine as a whole (Pentland and Feldman, 2005).

The second option, focusing on their dynamics, is more complicated. Firstly, Pentland and Feldman (2008) argue that examining performances can be quite hard as they are distributed over time and space unevenly. Therefore, it is open to the interpretation of the researcher. Furthermore, although dividing the routines into small parts is more useful to study, often larger units are easier to grasp. There are similar problems in examining the ostensive dimension. Firstly, they are distributed unevenly as well. Furthermore, not only it is in narrative form, but it is also often not possible to observe the ostensive dimension directly. Researcher need to rely on the actors' own account that can be completely different from each other for a specific routine. Pentland and Feldman’s (2008) suggestion is to use different narratives to grasp the whole of the ostensive dimension of the routine and to employ an etic / objective definition of the routine to avoid problems.

Finally, examining the artefacts can pose similar problems: actors’ views about them can be different from each other. Again, the remedy is the same – employing an etic view.

The fundamental problem in the operationalisation of organisational routines is its identification, which is not as easy as other units of analysis – its alternatives. There are three particular problems: (i) trying to be too concrete can be misleading (for instance equating artefacts to routines); (ii) routines are dispersed over time, space and actors, therefore it is not easy to see the whole picture even to distinguish a particular routine from another one; (iii) and finally variety in performances can be confusing (Pentland and Feldman, 2008).

Pentland and Feldman (2008) further argue that the study of a particular routine always starts with the ostensive dimension: the researcher asks the question ‘what is it you are doing?’ Therefore, there can be two different approaches in the study of the ostensive dimension: (i) to
identify the intended outcome: ‘what are you trying to achieve?’ and (ii) to identify the routine with respect to a particular event: ‘what do you do when x happens?’

5.6. Conclusion

Organisational routines are truly central to understand the behaviour of organisations. They are powerful as they provide coherent, applicable units of analysis to study stability and change in organisations. Although, it is not straightforward to study them, there are established strategies for this purpose.

As established in Chapter 2 and 3, behavioural additionality needs a unit of analysis – behaviour itself is not a unit of analysis and treating it as such would confine it to the input-output paradigm exactly as the proponents of the idea of behavioural additionality have criticised the mainstream literature. Therefore, organisational routines are the natural choices for a unit of analysis for behavioural additionality.
Part I

Chapter 6: Evolutionary Approach as a Framework of Analysis
6.1. Introduction

Mechanistic analysis of neoclassical theory in explaining and predicting economic and social change has led to the rise of evolutionary explanations. The evolutionary theories that put the evolutionary process at the core have been particularly successful in explaining the reality related with technology and process of its creation because of this constellation of evolutionary theories' particular power in explaining change. The relationship between the three kinds of additionality, and the neoclassical and evolutionary / structuralist dichotomy is that the first two kinds of additionality are at the heart of neoclassical rationale for technology and innovation policy while behavioural additionality is the hallmark of evolutionary policy for technology and innovation as already discussed in Chapter 4. The strong conclusion emerged from Chapter 4 was that if behavioural additionality is to be related to evolutionary logic of policy-making, it needs to embrace evolutionary explanation as the framework of analysis. This chapter is designed to provide an answer to that call and a basis for the second part of the thesis that builds up a new understanding of behavioural additionality. Therefore, the aim here is to discuss the basic and common features of evolutionary approaches to economic and social change (Section 6.2) and select a suitable evolutionary framework from this soup of different theories (Section 6.3) so that it can provide a basis for the rest of the thesis with some conclusions (Section 6.4).

There are three further issues that need clarification from the outset. The first issue is the suitability and appropriateness of evolutionary analogies for economic and social issues. It is a very well known stance in the literature that some scholars find the evolutionary economics inappropriate in principle, as they think i) it is genetic reductionism, and/or ii) biological metaphors and analogies are not capable of explaining social and economic phenomenon and/or iii) it has strong adverse political connotations (as social Darwinism was mainly used by Nazis). However, as also echoed by many scholars, most of the literature uses evolutionary principles rather than evolutionary analogies for one reason: the fundamental principles of evolution as set by Darwin constitute a general framework (and even an ontology) that can be applied to any discipline. (Aldrich et al., 2008; Hodgson, 2002; Hodgson and Knudsen, 2006; Metcalfe, 1998, 2005; Nelson, 2006). In light of this, it must be noted that, throughout this chapter in particular and the thesis in general, any evolutionary concept will be used independently from its biological context and defined accordingly. No analogies between organisational routines and genes or memes or any other biological concept will be drawn, and no biological organism will be compared with business organisations in terms of their evolution whatsoever. No link with the rather pejoratively used view of Social Darwinism will be established. In other words, while
universal Darwinism as coined by Dawkins will be applied, it will be used in its narrowest sense as described by Nelson (2006, 2007).

Second, it must also be noted that evolutionary economics is a vast literature with many diverse and sometimes conflicting opinions. As the aim of this chapter is not to review this literature per se but to discuss the fundamentals and to provide a conceptual basis for a new framework of analysis for behavioural additionality, the extent of the discussion will be shortened in some areas and some intellectually thrilling and important discussions will be avoided on the basis of their irrelevance to the general aim.

Finally, although the scope of this chapter is the evolutionary approach to understand economic and social change, particular emphasis will be given to evolutionary economics, almost exclusively in some parts, for the following three reasons. Firstly, as will be discussed below in more detail, evolutionary explanations for economic reality are more sophisticated and developed than those for social and other realms of reality. Secondly, as the focus of this thesis is behavioural additionality within the context of direct support to firms' innovative activities, the change that the behavioural additionality focuses on is mostly in the domain of evolutionary economics. Thirdly, as will be established later on this chapter, the term evolutionary economics will be used in such a way that covers explanations of the change in the economic sphere and the very connected and allied change in the social sphere.

6.2. General Features of Evolutionary Economics

The evolutionary approach to explain economic and social change is rich and diverse. It is a very well established line of thinking in economics stemming from Veblen and Marshall and increased in importance with Nelson and Winter (1982). It has also been used extensively in organisational and business studies (Aldrich and Ruef, 2006; Baum and Rao, 2004).

Dopfer and Potts (2008: 2) itemise the commonalities of evolutionary explanations to economy as a complex open system with following properties:

“non-linear, quasi-entropic, differentially replicative, partially stochastic, non-integral, non-equilibrium, boundedly rational, learning focused, behaviourally conditioned, self-organising, strategically interactive, environmentally composed, path-dependant, institutionally structured, co-evolutionary, discovery based, enterprise driven, technology and resource dependent, topologically complex, adaptive ongoing process of variation, selection and the replication in the growth of knowledge.”
The list given by Dopfer and Potts (2008) is very panoptic and condensed and thus needs an extensive discussion. This section will accomplish this aim by following the rather well focused frame of Dosi and Marengo (2007).

6.2.1. Dynamics First!

The fundamental endeavour of evolutionary theories is to grasp dynamics. Unlike neoclassical economic theory which focuses purely on ‘quantity / product questions’ (how much and if has something happened? what is the end-product?), evolutionary theories concern with ‘quality / process questions’ (why and how has something happened? what is the process?). Therefore, process is the focus and it can be provided by either a formal model of a dynamical system or qualitative historical reconstruction or both. Furthermore, explanations only relying on ex-post equilibrium, existence theorems and functionalist claims are not valid (Dosi and Marengo, 2007). For Friedman (1953: 4), the success criteria of the ‘positive economics’ is “the precision, scope, and conformity with experience of the predictions it yields” whereas for evolutionary theories, behaviour is not predictable and understanding the dynamics through patterns is the aim.

There are two further implications of the role of dynamics in evolutionary theory. Firstly, this links to the discussion of Chapter 4 on the methods of neoclassical and evolutionary theories: the dominant method of the neoclassical theory is Newtonian ‘comparative statics’ where one equilibrium is compared with another one by changing only one variable at a time and holding all the other constant (ceteris paribus) whereas for evolutionary theories, the dominant method is ‘dynamics’ where change is analysed processually without assuming any equilibrium state. Secondly and consequently, as Nelson and Winter (2002) point out economic reality is not static as most of the studies that employs neoclassical theory suggests and only a fully dynamic analysis could grasp the unanticipated and exogenously changing that is always in a transient phase, which renders the learning imperfect and the firm behaviour maladapted. As such, ‘comparative statics’ cannot satisfy the need for “an approach that keeps track of whole sequence of changes, which may extend over long periods of time” but ‘dynamics’ that evolutionary approach uses could offer an understanding (Witt, 2005: 394).

For Foster and Metcalfe (2001:5), evolutionary theory which essentially is concerned with ‘becoming’ than ‘being’ is naturally a growth theory. Knowledge change ad infinitum means economics systems are open, restless and irreversible. Knowledge-based systems are autocatalytic. The consequences of this perspective are that (i) there is no equilibrium in these kinds of restless systems and (ii) a predictive theory of novelty is not possible.

32 There are of course neoclassical studies that focus on the dynamics of their subject matter. However, the discussion here is in the general level. Furthermore, the terms dynamics and statics are used only in methodological sense.
6.2.2. Micro-foundations

Almost all of the studies that use an evolutionary approach to explain the economic and social change and particularly innovation do have micro-foundations in the sense that they give sufficient explanations and mechanisms as to how and why agents behave in a certain fashion. This implies that black-boxing is not permitted. In the particular case of firms, the micro-foundations are explained through routines at the organisational level and habits at the individual level as extensively discussed in Chapter 5.

6.2.3. Bounded Rationality

All evolutionary theories have the assumption of bounded rationality in common. This concept of bounded rationality a la Simon suggests that because the cognitive/mental capabilities of agents are limited as other physical and non-physical resources, agents have a limited understanding of their environments (other agents and the constraints they face) which ultimately leads to the fact that there is no ‘homo economicus’ (Todd and Gigerenzer, 2003).

6.2.4. Heterogeneous Agents

As already discussed in Chapter 4, for evolutionary theories, agents are heterogeneous as bounded rationality as well as imperfect and path-dependent learning render agents different from each other. This must not be mistaken with agent differentiation in neoclassical theories in which agents are differentiated by adjusting one certain parameter under otherwise same objective functions. For instance, in most of the models that investigate input additionality, firms are only different in size or risk perception etc. However, the heterogeneity in evolutionary theories is more fundamental in the sense that even similar agents (in terms of neoclassical ‘parameters’) face the same constraints and the information set is not presumed to behave in the same way. According to Dosi and Marengo (2007), an evolutionary theory needs to capture and explain the underlying reasons of heterogeneity in order to capture the aggregate dynamics.

6.2.5. Possibility of Novelty

Variation is the essential element of an evolutionary theory. Any such theory that does not count for novelty in terms of new technologies, organisational forms and behavioural patterns cannot capture the evolutionary dynamics (Dosi and Marengo, 2007).

Firms innovate and innovation involves change in routines but innovation itself in return is governed by routines as well33. Therefore, understanding innovation requires an understanding of

33 See Becker and Zirpoli (2008a, 2008b, 2009) for further discussion.
routines. However, “there are good ground that the innovation black-box will always remain partially closed.” (Foster and Metcalfe, 2001:9)

### 6.2.6. Selection Mechanisms

There are mechanisms to select different entities (routines, firms, technologies etc.). Although selection decreases variety, it increases differential growth.

Markets are selection environments. Appraisal criteria for markets are not the efficiency of allocation of given resources to given ends but markets’ “openness to new forms of activity and its capacity for eliminating obsolete activities” so that market facilitates selection. Markets are to facilitate change not stability (Metcalfe, 2005: 400; Schumpeter, 1934).

### 6.2.7. Nature of Firms

Firms are behavioural entities. In Table 10, a caricature dichotomy of the pure-incentive view of the firm of neoclassical economics and the pure problem-solving view of evolutionary economics are given. However, it should also be noted that “a fully-fledged evolutionary theory of the firm – or, perhaps better, of the genesis and change of firm organisations – does not yet exist.” (Witt, 2005: 361).

#### Table 10: A Caricature of Two Views of Firm

<table>
<thead>
<tr>
<th>Dimensions of analysis and theoretical building blocks</th>
<th>Pure incentive view (Neo-classical Economics)</th>
<th>Pure problem-solving view (Evolutionary Economics)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem-solving / cognition / knowledge</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Incentive governance</td>
<td>Yes (central dimension of analysis)</td>
<td>Not so far</td>
</tr>
<tr>
<td>Behavioural micro-foundations</td>
<td>Perfect, far-sighted rationality</td>
<td>Bounded rationality (usually with myopic attributes)</td>
</tr>
<tr>
<td>Organisational behaviour</td>
<td>Strategic (in the game-theoretic sense)</td>
<td>Driven by routines, heuristics, rules, etc.</td>
</tr>
<tr>
<td>Learning</td>
<td>No</td>
<td>Yes (central dimension of analysis)</td>
</tr>
<tr>
<td>Unit(s) of analysis</td>
<td>Transactions</td>
<td>Elementary 'bits' of knowledge</td>
</tr>
<tr>
<td></td>
<td>Strategies</td>
<td>Routines and other elementary traits</td>
</tr>
<tr>
<td></td>
<td>Allocation of information</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Allocation of property rights</td>
<td></td>
</tr>
<tr>
<td>Non-economic dimensions of organisations</td>
<td>Not as 'primitive' dimensions</td>
<td>Power, trust, identity building etc.</td>
</tr>
</tbody>
</table>

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34 Taken from Dosi and Marengo (2007)
6.2.8. Learning and Routines

As discussed in Chapter 5, firms learn on their own (innovate) or learn from each other (imitate). For anything to be learnt, it must be converted into a routine within the firm and therefore shared by both the individual entities that form this particular routine and also the firm itself. The learning at the firm level is wider than the learning in the individual parts as the whole is larger than the sum of its parts. Similarly, learning is governed by routines. As will be discussed later in this chapter and discussed already in Chapter 5, learning is a structured process that is governed by particular routines.

6.2.9. Processes of Evolution

According to Metcalfe (2005: 394), there are three principles of the evolutionary process in a world of mutual coordination and supporting ideas of interaction:

- Principle of variation: “members of a relevant population vary with respect to at least one characteristic with selective significance.”
- Principle of heredity: “there exist copying mechanisms to ensure continuity over time in form and behaviour of the entities in the population.”
- Principle of selection: “the characteristics of some entities increase in numerical significance relative to less well-adapted entities.”

Metcalfe (2005) also discusses the five processes of evolution according to Endler and McLellan (1988):

- Process that generates variation in the pool of characteristics by adding or removing entities or changing the characteristics of them: this is innovation according to Metcalfe (2005) which changes firms and their entry and exit,
- Process that restricts and guides the possible patterns of variation: because of inertia and constraint, the variation space is limited and not all possible behaviours are adaptable according to Metcalfe (2005),
- Process that changes the relative frequency of entities: this is the market mechanism according to Metcalfe (2005),
- Process that determines the rate of the first three,
- Process that determines the overall direction of the change: together with the above point, it is the overall framework of institutions and behavioural norms according to Metcalfe (2005).

Therefore Metcalfe (2005) suggests a three stage evolution consisting of initial variation, selection and revised variation.
6.2.10. Population Thinking

Metcalfe (2005) argues that variation is a fact of the economic reality. However, conventional economics treats this variety as an accidental variation from the ideal type whereas evolutionary economics focuses on this very concept in its study. For evolutionary economics, rather than ideal uniformities, frequencies of different types are more important. Therefore, the focal point of thinking is not representative agents but population of different agents.

6.3. A General Theory of Evolutionary Economic Change

This section focuses on the evolutionary framework developed by Kurt Dopfer and Jason Potts (Dopfer et al., 2004; Dopfer and Potts, 2004, 2008, 2009). The reasons why a particular framework is discussed and why Dopfer and Potts (D&P) framework is particularly selected are intertwined. Firstly, because it is clear that the aim of the thesis is not to contribute to the evolutionary theory per se but primarily to utilise it to provide a framework of analysis for behavioural additionality, a pragmatic approach must be employed in accomplishing this objective. As the depth and diversity of discussions in evolutionary economics are given and also the fact that a full-fledged evolutionary theory especially in understanding firm behaviour has not yet been written, the D&P framework is the obvious choice as the most complete and recent attempt as a framework of analysis. Secondly, in addition to its completeness, the D&P framework is also generic and applicable to different contexts. Most of the evolutionary frameworks developed by other scholars are too context-sensitive and either it is not possible to apply them to other contexts or it is simply too costly to do so. The D&P framework, however, has its own caveats (Runde, 2009). These issues will be discussed throughout this section and where possible the gaps of the D&P framework will be filled or complemented by other scholars’ work in line with the general features of the evolutionary theory discussed above.

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35 See the discussion above and Witt (2005: 361). Briefly, it can be argued that because i) evolutionary concepts are not as mechanistic as neoclassical ones, ii) and also evolutionary economics is not as mainstream (and therefore mature) as neoclassical economics, evolutionary frameworks are generally on the level of general ideas rather than elaborate theories.
6.3.1. The General Features and Unit of Analysis of the D&P Framework

According to Dopfer and Potts (2008, 2009), the aim of evolutionary economics is to explain the following two observations:

(i) the economy is largely self-coordinating
(ii) the structure and content of the system are continually changing

To this end, evolutionary economics utilises a generic analysis as summarised in Table 11. Neoclassical economics works at the level of operational analysis, which only focuses on the material growth related to the value of the inputs into the production and the value of the subsequent outputs. This operational analysis can explain economic growth in a limited fashion far from shedding light on economic evolution. To do this, however, the structural, institutional and knowledge-base change as open and complex processes should be investigated. Therefore, one should focus on the ‘generic level’ of the economy as “an analytical level referring to ideas, rules and knowledge, which constitutes the basis of the economic operation” rather than the ‘operational level’. The term generic has emphasis in generation in the sense that these “ideas, rules and knowledge” generate others and the evolution itself (Dopfer and Potts, 2009: 24). The operational analysis focuses on transactions (of inputs as scarce resources) and transformations (of input to outputs) whereas their generic analysis focuses on origination, adoption and retention of generative ‘ideas, rules and knowledge’. The source of economic problem is the allocation of scarce resources for operational analysis of neoclassical analysis whereas for evolutionary economics it is the coordination and change of these generative ‘ideas, rules and knowledge’.

Table 11: Operational and Generic Economic Analysis

<table>
<thead>
<tr>
<th>Analytic Level</th>
<th>Applied to</th>
<th>Processes</th>
<th>Economic Problem</th>
<th>Analytic Mode</th>
<th>Framework</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational Analysis</td>
<td>scarce resources, rational choice</td>
<td>transactions &amp; transformations</td>
<td>allocation of scarce resources</td>
<td>equilibrium</td>
<td>neoclassical economics</td>
</tr>
<tr>
<td>Generic Analysis</td>
<td>generic rules, generic choice</td>
<td>origination, adoption, retention</td>
<td>coordination &amp; change of rules</td>
<td>complexity, evolution</td>
<td>evolutionary economics</td>
</tr>
</tbody>
</table>

36 Taken from Dopfer and Potts (2009)
The unit of analysis of the D&P framework is what they call ‘rules’. These rules are defined as the combination of “conceptions of behaviours, knowledge base and institutions” or in other words they are “deductive generic procedures for economic operations which specify what to do, how to combine things” (Dopfer and Potts, 2009: 26). Combined with resources these rules produce value. Dopfer and Potts argue that “the main point of departure for evolutionary economics concerns the notion of universal objective and subjective laws” (Dopfer and Potts, 2008: 20). Change in these rules, therefore, is the very process of economic evolution.

Dopfer and Potts’ rules are classified into two broad categories as summarised in Exhibit 14: subject rules as the rules related with the subject of the economic reality (economic agent: individual or firm) and object rules as the rules associated with the objects of the economic reality. Within subject rules, there are two further types. Cognitive rules are for organising thoughts whereas behavioural rules are for organising their actualisations. Within object rules, social rules are for organising people whereas technical rules are for organising material objects.

Exhibit 14: Rule Taxonomy: Subject and Object rules

What Dopfer and Potts call a ‘rule’ is in fact very close to the very well established concept of ‘routine’ even though, for some reason, Dopfer and Potts do not refer to routines. In fact, they mention the word ‘routine’ only in two instances in their book, one of them in a non-technical fashion while the other is explicitly synonymous to ‘rule’ (Dopfer and Potts, 2009). Their conception of rules is nothing but the very conception of routines for the following three reasons. Firstly, the very definition of rule as they coined and discussed above fits very well with the definition of the concept of routine, which is discussed in depth in Chapter 5. Secondly, their taxonomy of rules is consistent with the understanding of the routines literature. For instance, as

37 Taken from Dopfer and Potts (2008, 2009)
38 The terminological problems of the D&P framework are discussed by Runde (2009).
discussed in Chapter 5, Pentland and Feldman (2005, 2008) point out the ostensive and performative nature of routines: routines are in cognition (in the mind of the people) and also in the practice. This is the very difference between the cognitive and behavioural rules in the D&P framework. Similarly, the role of the social process (social rules) and artefacts and technologies (technical rules) in routines are studied in great detail in the routines literature and also discussed in Chapter 5. Furthermore, Nelson (2009a) elaborates that their definition of routine in Nelson and Winter (1982) includes i) the concept of routine as organisational capability with cognitive and behavioural dimensions and ii) the concept of routine as technology (production technique). Thirdly and finally, as addressed extensively in the literature, the main unit of analysis of evolutionary economics is routine and there is no reason to distinguish the term ‘rule’ from the term ‘routine’ for the purpose of this thesis. Therefore, the D&P concept of ‘rule’ will be read as ‘routine’ for the rest of the chapter and thesis. One word of caution here could be the extent of routines. According to Nelson (2005; Nelson and Sampat, 2001), for example, widely accepted and practised routines (or cluster of routines) form what he calls ‘social technologies’ and ultimately institutions. Therefore, there is a link between routines and institutions or other concepts at that level. For rules, as will be discussed in the next page, this link is more direct: D&P prefer to call some institutions as rules. However, in essence, the logic is the same and there is no real difference if rules and routines are used synonymously, at least in the micro level. Therefore, I will use the terms ‘rule’ and ‘routine’ interchangeably throughout the thesis.

Rules (or routines as we understand) are further categorised according to their order (Table 12). In the D&P framework, 0th order routines/rules refer to a constitutive level, which includes social, legal, political and cultural rules. These rules are ‘the rules of the game’ and form a ground under which all actors behave. Free market competition and all the corresponding rules/routines are 0th order, for example. In the 1st order, there are operational rules. These are, in the simplest definition; rules / routines that define what a rule carrier (individual, firm, meso units and the economy) can do / perform / operate. They transact and transform resources. According to Dopfer and Potts (2009), this is the only order that the neoclassical theory is close to capture. In the 2nd order, there are mechanism rules for changing 1st operational rules and also 2nd order mechanism rules themselves. Therefore, they are the rules for origination, adoption and retention of rules. They are the rules/routines that generate variety and they govern how a rule carrier innovates. 2nd order rules are particularly important given the discussion of the role of routines for creating innovations within firms. Order taxonomy is the most original and potent dimension of the D&P framework. Both the order and subject-object taxonomy of rules/routines will be a critical component of the coming discussion of the stages of evolution in the next section in this chapter and also the next chapters.
Table 12: Rule taxonomy: Orders of Rules\textsuperscript{39}

<table>
<thead>
<tr>
<th>Rule Order</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0\textsuperscript{th} order constitutive rules</td>
<td>Social, legal, political, cultural, and other constituent rules that underpin generic rules for economic operations</td>
</tr>
<tr>
<td>1\textsuperscript{st} order operational rules</td>
<td>Generic rules originated, adopted and retained by carriers for operations</td>
</tr>
<tr>
<td>2\textsuperscript{nd} order mechanism rules</td>
<td>Rules for changing rules. The origination, adoption and retention of rules about origination, adoption and retention.</td>
</tr>
</tbody>
</table>

6.3.2. Micro-Meso-Macro Framework

Another original contribution of the D&P framework is the micro-meso-macro framework. They define a level of analysis for rule-carriers (micro), rule-trajectories (meso) and the whole economy (macro). These will be discussed thoroughly in the coming pages but before that, a couple of remarks on the importance of this framework are needed. The focus of analysis in neoclassical economics is micro. Agents, mostly representative, behave in certain ways with certain assumptions and create some outputs with certain inputs. The sum of all these micro agents constitutes the macro. In evolutionary economics, several scholars pointed out that this summing-up logic is simply not true: the whole is greater (or at least different) than the sum of its parts as there are intermediate operations (at least population dynamics as discussed above). Therefore, a meso level has always been advocated in evolutionary studies.

The D&P framework formalises the link between micro, meso and macro levels. Meso is the aggregation of micro, whereas macro is the aggregation of meso. Therefore, meso constitutes the link between micro and macro as summarised in Table 13.

The micro level is where rules / routines and their carriers (individuals and firms) are the units of analysis. The concern of microevolutionary economics is the process of origination, adoption and retention of a rule in one carrier. The meso level is where rule trajectories (the processes that the rules change) and their carrier populations are analysed with a focus on the process of adoption and retention of a rule in a carrier population. Mesoevolutionary economics studies how a rule is innovated in one carrier and then subsequently adopted by others. Finally, the unit of analysis for macro is the whole economy and the complex self-organised system of meso units. Macroevolutionary economics is concerned with how deep and surface coordination is de-

\textsuperscript{39} Taken from Dopfer and Potts (2008, 2009)
coordinated and re-coordinated in consequence of a meso trajectory. These three levels of evolution will be discussed thoroughly in the following sections.

Table 13: Micro-Meso-Macro Framework

<table>
<thead>
<tr>
<th>Unit of analysis</th>
<th>Concern</th>
<th>Trajectory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Evolutionary microeconomics</strong></td>
<td>Agent (individual), Agency (firm), Rules for operations, Rule carrier, Complex system of rules</td>
<td>The process of origination, adoption and retention of a rule in one carrier</td>
</tr>
<tr>
<td><strong>Evolutionary mesoeconomics</strong></td>
<td>Generic unit, Rule and rule carrier population</td>
<td>The process of adoption and retention of a rule in a carrier population. How a rule is innovated in one carrier and then subsequently adopted by others.</td>
</tr>
<tr>
<td><strong>Evolutionary macroeconomics</strong></td>
<td>Whole economy, Complex self-organised system of meso units</td>
<td>Trajectory: how deep and surface coordination is de-coordinated and re-coordinated in consequence of a meso trajectory.</td>
</tr>
</tbody>
</table>

6.3.3. **Micro Trajectory**

This is the stage of evolution where a particular rule / routine is originated, adopted or retained within a particular firm. The unit of analysis is a single rule / routine and its carrier: a single firm. The D&P framework distinguishes the micro units of analysis as the agent (individual) and agency (firm). Both of these units carry and use routines as knowledge and they also originate, adapt and retain new rules. Therefore, they possess knowledge and change it. Neoclassical microeconomics is only concerned with the former dimension whereas evolutionary economics is about both of them as dynamics (the way the agents change the knowledge they have in this context) is the main focus.

In neoclassical view, there is one single representative agent where all the laws of economics can be derived with careful analysis. This agent has one rule / routine: it behaves rationally. However, although evolutionary economics is also methodologically individualist, the individual here has more than one routine, which can change. Furthermore, “the process these rules [routines] change” is the main issue. Additionally, for evolutionary economics, there is a population of agents.

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40 This chapter and the rest of the thesis will focus on the latter.
Micro trajectory includes three stages: origination, adoption and retention. These will be discussed below.

**6.3.3.1. Micro I: Origination (Creativity/Access)**

This is the phase in which new routines are formed. Micro I is essentially a variety generating process. According to Dopfer and Potts (2008, 2009), this process mainly starts from the agent (individual) and develops from the other parts of the agency (firm). This routine can be locally novel (novel to the firm) or globally novel (novel to all firms). A novel routine can be discovered by a wide variety of ways ranging from a search of all-already-pre-existing routines within the environment to the invention of routines out of the blue. These search mechanisms are discussed in more detail in Chapter 5 on routines. Dopfer and Potts (2008, 2009) stress that the objective (cognitive and behavioural) and subjective (social and technical) nature of the rules / routines add an extra complexity dimension to the origination phase as these four elements must be in present and working together for a routine to be originated.

origination of a new routine in a generic firm is done by already existing 2nd order routines (routines for changing routines) in this firm. This is also discussed in great detail in Chapter 5 as routines to create new routines. The newly originated routine, then, is either 2nd order mechanism routines itself or 1st order operational rule. Dopfer and Potts (2008, 2009) argue that firms have little capacity to change 0th order constitutive rules / routines (social, legal, political, cultural, and other constituent rules / routines) as they are mostly given and decided exterior to the firm.

Some firms have more capacity to carry or create better and more 2nd order routines while some other firms will be limited in this perspective. Those with better 2nd order routines will have more chances to originate 1st and 2nd routines and therefore survive.

Based on Nelson and Winter (1982), Becker (2001) suggests the following sources of variety as a result of the origination process which are all governed by 2nd order routines:

- **Mutation:** New routines are originated through mutation of existing routines. The classical drivers of mutation are imperfect replication and tacit knowledge. Routines are mutated in an imperfect fashion in a firm. Whenever a routine is mutated/originated, it varies. Similarly, because the routines are adapted through tacit knowledge, the origination process creates variety. On top of these two drivers of variety in an origination process, Becker (2001) also adds creativity, chance and error as further drivers.
• Recombination: The same drivers change the sequence of an existing group of routines. As small routines form larger ones, a change in a sequence of a series of routines (a recombination) originates a new routine.

• Migration and Diffusion: At the micro level this refers to the diffusion of routines to different actors who enact them, i.e. from one individual to another, from one department to another, etc.

6.3.3.2. Micro II: Adoption (Learning/Imitation)

After the first stage of an origination of a rule / routine into a firm (Micro I), this rule / routine is not embraced by the firm in some cases. This means in reality nothing changes within the firm and therefore operations of the firm remain unaffected. However, the routine that was originated can also be embraced. In that case, adoption occurs.

Adoption means a routine persists. As discussed in Chapter 5, if a routine is exercised only once, it does not persist and therefore not adopted. Adoption generates stability and balances the change generated by origination in the firm level (Becker, 2001).

Adoption of a routine does not necessarily increase the survival chance of the firm. For neoclassical economics, firms have perfect foresight on the marginal benefit and costs of adoption of a rule and only adopt if the marginal benefit is equal or greater to the marginal cost of adoption. However, in reality, firms adopt a rule with imperfectly constructed expectations and sometimes at the expense of their chances of survival.

Adoption of a routine is a complex enterprise as it is not isolated but works in the context of other routines within the firm. Therefore, some routines fit together with the routine complex whereas others do not, as they are incompatible. Furthermore, the effectiveness and efficiency of adoption of a new (1st or 2nd order) routine are decided by the efficiency of 2nd order routines that generate other routines. This is indeed the very concept of absorptive capacity (Cantner and Pyka, 1998).

Adoption is a broader concept than learning. Learning entails the introduction of the knowledge of a new routine yet does not go as far as application of the routine. Adoption, however, must include learning and also application of what is learned. Learning does not necessarily lead to evolution of the firm, but adoption is a process of evolution.

6.3.3.3. Micro III: Retention (Normalisation)

This phase of the microeconomic evolution occurs when a firm widely applies a routine within all its operations. In that case, the rule becomes an essential and established part of the routine
complex and therefore the firm. In other words, the routine normalises or becomes the lifestyle of the firm.

6.3.3.4. Features of Micro Evolution

Having discussed the phases of micro-economic evolution (of rules /routines), a few remarks on i) the difference of biological evolution and evolution of routines and ii) the conditions of an efficient evolution of routines would be needed.

For Nelson (2009a), biological evolution is quite different than the evolution of routines as

(i) In biological evolution genes cannot be chosen by entities (i.e. they are fixed for entities) whereas economic agents can control their routines (i.e. they are not fixed for firms),

(ii) Firms change their routines with a degree of purpose, deliberation, decision making and rationality (even though it is bounded),

(iii) Variation in biological domain is in genes (genotype) and behaviour and traits (phenotype) whereas for evolutionary economics it is a more cognitive issue (as the actualisation of a routine is only one of its countlessly many understandings in a given firm)

(iv) In evolutionary economics, the routine is shared not only by people within a particular firm but also other people in other firms, trade associations, scholars, etc. (for example new routines might be evaluated by business school professors and firms benefit from it).

Similarly, Nelson (2009a: 16-17) sets out the following conditions for a routine to evolve more rapidly and efficiently:

(i) There must be some degree of routinisation for changing routines. In other words, there must be proper 2nd order routines in place.

(ii) The routine carrier must have strong and consistent beliefs that they avail from the change in routine. Condition (i) is necessary for this.

(iii) Carriers must learn from experimentation (i.e. various changes in their (or other carriers’) routines) and be able to act accordingly. Condition (i) and (ii) are necessary for this.

(iv) Experimentation can become much more cost efficient if the routine in question is “modelled” ex ante. This model “must provide reliable information about what will work with the real routine”.

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6.3.4. Meso Trajectory

Here, the unit that evolves is a population of rules / routines and also a population of carriers of a particular rule / routine. The unit of analysis in meso analysis is the meso trajectory, which is the process of change in the meso level. Three phase meso trajectory (origination, adoption, retention) form up the meso unit of analysis.

6.3.4.1. Meso I: Origination

When a full cycle is completed for the micro trajectory, i.e. a routine is originated, adopted and retained within a single firm, an innovation occurs. This starts the Schumpeterian process of creative destruction: the particular firm gains a monopoly position and the existing pattern of population of routines and routine carriers disrupt (Schumpeter, 1934).

In more detail, whenever a full micro cycle is completed, a routine becomes available for other firms to be adopted. Similarly, whenever a micro cycle is completed for a particular routine, it means that the rule is fit into a rule complex and becomes a part of a wider unit. Furthermore, it generates competition between routine carriers as it gives a monopoly status. Finally, a particular routine has a consequence for profit, only if a full cycle is completed.

Therefore, the routine begins to spread and crosses the boundary of firm. This is essentially the process of innovation itself. Analysis of this process reveals creation of institutions, technologies, industries and markets and also the failure stories in these.

The sub-phases of Meso I are (i) creation of novel idea which leads to an increase in the innovation potential and (ii) a process formed by search, discovery and recognition which leads to selection (Dopfer and Potts, 2009: 34).

6.3.4.2. Meso II: Adoption

After the completion of full micro trajectory and also Meso I, (origination of this rule to a routine carrier population and creation of a routine population) these routines are adopted by a population of routine carriers. Of course, adoption is a path dependant process: as the information is asymmetric and competition is imperfect, a routine is adopted differently in different carrier populations. Therefore, a differential growth occurs and variety within population of routines and their carriers increases. Meso 2 is what Metcalfe (2005) calls ‘restless capitalism’. This is the process where there is blood and tears, profit and losses, creation and destruction.

According to Dopfer and Potts (2009: 34), two sub-phases of Meso II are (i) first adoption of innovation which leads to chaos and radical uncertainty and (ii) wide-spread adoption which leads to selective environment and path-dependence.
6.3.4.3. **Meso III: Retention**

After the introduction of a novel routine to a population and its wide adoption, the routine becomes established within the population of firms. This rule / routine is now adopted by all those who can and the rule population fluctuates in a level that is not enough to change it systematically. This rule becomes an institution and part of the collective knowledge-base. Dopfer and Potts (2008: 50) define these institutions as “a rule population that statistically replicates at some stable frequency” and this is exactly the stage where what Nelson (2005: 50; Nelson and Sampat, 2001) calls ‘social technology’ is created.

6.3.4.4. **Features of Meso**

Dopfer and Potts (2008, 2009) illustrate the meso evolution – evolution of a rule / routine population – with a logistics (S) curve as reproduced in Exhibit 15. In this way, at the beginning a new rule/routine/idea completes its micro journey and is originated into the meso level (i.e. becomes available for other firms to adopt). In this phase, uncertainty is high and, finance problems prevail. Then, if this is taken up by other carriers, it gets to Meso II level: adoption. Here a variety is created mainly because of three reasons. First, a rule / routine can be used for different purposes (rule / routine variety). Second, carriers of this rule create a variety (carrier variety). Finally, different applications of this rule create a variety (operational variety). At the final stage, if the rule gets through Meso I and II levels, this rule saturates and it is retained through Meso III.

The scale of a meso trajectory matters. Some rules / routines are larger than others. They span a larger carrier population or they have larger economic significance. Dopfer and Potts (2008, 2009) argue that the distribution is power-law: there are numerous small meso units; when they get larger, the scale decreases. However, the process of economic evolution is independent of the scale: they evolve with the same principles and impact the macroeconomic system.

Similarly, the velocity of meso trajectory matters as well. Some meso trajectories change faster than others not only because of network externalities but also because of the effectiveness of 2nd order rules in place.
6.3.5. Macro Trajectory

The D&P framework argues that the aggregation of all meso units (rule populations) constitutes a macro order. They constitute a surface structure in which all rule populations fit together (in terms of their actualisations) and also a deep structure in which rules and rule populations connect to each other (both in terms of their understandings and actualisations). These two structures can fail to coordinate for three reasons. First, operant coordination failure can occur in cases where rules fit together but their operationalisations do not due to capacity maladjustments. This is essentially the business cycle as appreciated by neoclassical economics. Second, there is surface coordination failure in which rules fit together but in the presence of under-adoption or over-adoption. Lock-in to a cluster of inferior technologies is an example. Finally, deep coordination failure occurs when rules do not fit together. The three processes by which the macro trajectory evolves are the following.

6.3.5.1. Macro I: De-coordination

A rule / routine finishes its journey through the micro trajectory and then the meso trajectory, therefore becomes an institution (or social technology) and reaches to such a critical level that it impacts the growth of the economy and also all the other associated rules. In this case, it de-coordinates otherwise coordinated macro order.

41 Taken from Dopfer and Potts (2009: 35)
6.3.5.2. **Macro II: Re-coordination**

The institutionalised rule/routine that led to de-coordination in the macro order settles and stabilises. The macro order self-organises and reforms itself.

6.3.5.3. **Macro III: New order**

Re-coordinated macro order is now absorbed by all meso units and the economy reaches to a new order. The evolution of the economy is completed until a next iteration.

**6.4. Conclusion**

Chapter 2 and 3 concluded that the concept of behavioural additionality is vague, mostly misunderstood and underutilised both by scholars and evaluation practitioners because i) it lacks a unit of analysis and ii) it needs a better fitting framework of analysis. Chapter 4 reiterated these conclusions, especially the fact that as a key issue for the evolutionary rationale for innovation policy, behavioural additionality needs to embrace an evolutionary framework of analysis. Chapter 5, then, surveyed the concept of organisational routine and proposed it as the needed unit of analysis. This Chapter, finally, not only introduced the general features of the evolutionary approach to economic and social change but also discussed a particular framework within this literature.

The particular framework presented herein is appropriate and fit for the re-conception for behavioural additionality in several aspects. Firstly, as any evolutionary framework, the D&P framework is built around the explanation of change. This is done in particular analytical steps and through routines as unit of analysis as already proposed in Chapter 5. Given the fact that the concept of additionality is in fact a concept of change, this framework fits well in explaining it. Secondly, as the concept of behavioural additionality is linked with persistence and stability, the D&P framework fits well to the purposes as i) it uses the concept of routine which is widely discussed as a source of stability and persistence ii) and it is also very powerful in explaining how this stability and subsequent change (and therefore evolution) occurs.

The remaining task is, now, to utilise the concept of organisational routines as a new unit of analysis and the D&P framework as the framework of analysis in order to offer a new understanding for behavioural additionality.
Part II: Towards an Evolutionary Understanding of Behavioural Additionality
Part II

Chapter 7: Research Design
7.1. Introduction

This chapter gives the details of the research design. The next section is devoted to the epistemological stance. Section 7.3 outlines the research questions, research orientation, and scope. Finally, Section 7.4 explains the research strategy.

7.2. Epistemological Stance

The neoclassical view on additionality that stresses input and output additionality implies a strong commitment to the positivist stance. As discussed in Chapter 4, the rationale for government intervention is clear and the role for intervention is crudely considered to be causal and linear. Market failure can be remedied by counter-action and a policy following the causal link is the right form of solution. Similarly, if the data is collected properly, if and how the aim is accomplished can be evaluated and measured by using a precise quantitative scale. Econometric methods show the reality in its full truth provided that they are methodologically correctly exercised.

Evolutionary theory, however, perceives the world as being more complex than neoclassical theory. Reality cannot be studied by decomposing it to its components; in other words, population dynamics matter. Similarly, although there are regularities and patterns, reality does not always work in simple causal ways. This brings us sufficiently in line with Roy Baskhar’s critical realism. The real world consists of ‘real’, ‘actual’, and ‘empirical’. The ‘real’ is ‘the underlying causal properties and powers of nature’ (Elger, 2010: 256). It is how the economic evolution and therefore behavioural additionality as a force that influences it works. However, the ‘actual’, the particular outcomes and the events in the world we live in triggered by causal mechanisms in particular cases, is not same with the ‘real’ as the right context conditions are required, i.e. reality can “exist unexercised”. Therefore, how behavioural additionality and economic evolution surface is not always the whole story. However, it is also not entirely chaotic; there are patterns and frameworks. There is also the ‘empirical’, the way the researcher as a human being perceives the ‘real’ and ‘actual’. For sure, as the ‘empirical’ is only fallible, it does not correspond to either actual or real. Therefore, evaluation is not capable of showing us either the real or actual in their bare truth. Behavioural additionality must be understood by looking at the actual but also recognising the highly sensitive context conditions that differentiate it from the real. Thus, rather than generalising particular instances by using crudely quantitative methods, patterns and overarching causal mechanism, i.e. evolutionary forces, must be understood (Clark, 2008; Jaccard and Jacoby, 2010).
7.3. Research Questions, Orientation and Scope

This thesis has two fundamental research questions:

- How behavioural additionality is currently understood and used?
- How behavioural additionality must be understood?

Part I of this thesis has focused on the first question from different perspectives. Chapter 2 and 3 have identified that behavioural additionality needs a better unit of analysis. Chapter 5 has suggested the concept of organisational routine as a candidate for this. Similarly, Chapter 6 presented an overview of the evolutionary approach to economic and social change to provide a possible answer to the conclusions given by Chapter 4 that the framework of analysis of behavioural additionality must embrace an evolutionary view. These, in turn, provide the basic answer to the second question: behavioural additionality should be understood as the evolutionary change of organisational routines because of government intervention. However, this basic definition needs to be substantiated by developing a new understanding that explains the levels, phases, processes, and implications of behavioural additionality. This is the objective of Part II.

This research is theory-oriented rather than practice-oriented. While the objective of the practice-oriented research is “to contribute to the knowledge of one or more specified practitioners”, theory-oriented research aspires to contribute to theory development which might or might not be useful for policy-making eventually (Dul and Hak, 2008). The difference between these two types of research is summarised in Table 14. The main aim of this thesis is to provide a new theoretical basis for behavioural additionality for which I have identified two main problems of under-theoretisation. The objective is to contribute to the limited knowledge base on these fundamentally theoretical and rather abstract issues. This also has theoretical implications on the general issues of policy-making. However, practical (and operational) questions such as the evaluation of behavioural additionality in a particular setting are considered as secondary and can only be explored after a sound theoretical basis is established. Therefore, these kinds of issues will only be discussed for the sake of exemplifying or entertaining a theoretical issue and therefore operational questions will be areas of further research.
Table 14\textsuperscript{42}: Practice-Oriented versus Theory-Oriented Research

<table>
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<tr>
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<th>Practice-oriented research</th>
<th>Theory-oriented research</th>
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<tbody>
<tr>
<td>Objective</td>
<td>To contribute to the knowledge of one or more specified practitioners.</td>
<td>To contribute to theory development which might be eventually useful for policy-making</td>
</tr>
<tr>
<td>Success Criterion</td>
<td>An empirically correct conclusion about a practical object of study is reached (such as the conclusion that a specific outcome has been achieved)</td>
<td>A general conclusion applicable to wide variety of objects of study</td>
</tr>
</tbody>
</table>
| Relevance of Empirical Data | The basis for collection of facts  
The main issue                              | A contribution to the robustness and generalisability of a specific theoretical explanation |

Dul and Hak (2008: 38) define a theory as “a system of propositions (relations between concepts) regarding an object of study in a specified domain”. The new theory of behavioural additionality has the following features:

- **Object of study** (the stable characteristic in the theory) is the change of behaviour by government intervention

- **Concepts** are the variable characteristics of theory. Measurable concepts are called variables. As I have already described, the new theory of behavioural additionality utilises the concept of organisational routines as the unit of analysis and the concept of economic evolution as the framework of analysis. Therefore, these two consist of the ‘conceptual framework’ / ‘theoretical framework’ / ‘idea context’ defined as “the system of concepts, assumptions, expectations, beliefs, and theories that supports and informs the research” (Maxwell, 2005: 33).

In most of the cases, conceptual frameworks are taken as given and with small adjustments they can be applied to particular research contexts. However, the conceptual framework in this thesis is partially constructed. Although organisational routines have been one of the foremost units of analysis for evolutionary economics, the volume of theoretical research and its genuine applications are rather limited. Therefore, the research is one of the rare examples of the co-utilisation of both concepts in this particular context and thus provides another utility.

\textsuperscript{42} Taken from Dul and Hak (2008)
Propositions are (causal and non-causal) relationships between concepts. The theory produces a system of propositions that explain how organisational routines evolve by government intervention. The theory produces propositions in the form of the phases, levels, process of evolutionary change.

A theory should have a domain in which the instances of the object of study for which the propositions of the theory are believed to be true. The domain of the theory of behavioural additionality is limited by the evolution of organisational routines by government intervention in the form of innovation policy. As I will discuss later on in the research strategy, the empirical module of the research focuses on innovation grant programmes targeting firms as a particular innovation policy action for illustrative purposes. For the clarity, coherence, and continuity of argumentation, the whole thesis is limited to this domain, while the theory is also applicable to other innovation policy tools targeting different types of beneficiaries.

There can be two kinds of theory building research. Proposition building research aims to explain the relationships between known concepts or concepts that have already known relationships while descriptive research explains relationships between concepts that are unknown or concepts that have no explored relationships. This research blends these two types. On one hand, it builds propositions by applying two already interrelated concepts of organisational routines and evolutionary theory to the uncharted domain of innovation policy evaluation as discussed above. On the other hand, it is a descriptive research, as it provides a fresh look into the relationship between these two as well as the issues of government intervention and additionality.

7.4. Research Strategy

Following the two basic research questions, this thesis has three pillars in its research strategy. First, the problem with the current understanding of behavioural additionality should be understood through critical literature reviews and quantitative analysis. Consequently, conceptual tools / frameworks should be understood and assessed if they are relevant. Finally, the problems outlined in the former should be addressed by utilising the concepts introduced in the latter as depicted in Exhibit 16.
Exhibit 16: Research Design

Part II Chapter 7: Research Design

Chapter 2
Critical Literature Review
Technology and Innovation Policy Evaluation Literature (focused on additionality)

Chapter 3
Original Exploratory Quantitative Research
Technology and Innovation Policy Evaluation Practice (focused on additionality)

Chapter 4
Critical Literature Review
Technology and Innovation Policy-Making Literature (ES and NC policy rationales)

Chapter 5
Informative Literature Review
Organisational Science Literature (organisational routines)

Chapter 6
Informative Literature Review
Literature on the Evolutionary Approaches to Social and Economic Change

Chapter 8
Theory Building Research
Behavioural additionality as the evolution of organisational routines by intervention

Chapter 9
Theory Illustration Research
Two case studies as partial plausibility probes
7.4.1. Problem Identification

The problem identification stage includes two different literature reviews and a module that employs an original quantitative analysis. The designs of these modules, each corresponding to a chapter, are explained below. The taxonomy to characterise the literature review sections is given in Table 15.

Table 15: Taxonomy of Literature Reviews

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Categories</th>
</tr>
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</table>
| **Focus**       | Research findings  
|                 | Research methods  
|                 | Theories  
|                 | Practices or applications |
| **Goal**        | Integration  
|                 | Generalisation  
|                 | Conflict resolution  
|                 | Linguistic bridge-building  
|                 | Criticism |
| **Perspective** | Neutral representation  
|                 | Espousal of position |
| **Coverage**    | Exhaustive  
|                 | Exhaustive with selective citation  
|                 | Representative  
|                 | Central or pivotal |
| **Organisation** | Historical  
|                 | Conceptual  
|                 | Methodological |
| **Audience**    | Specialised scholars  
|                 | General scholars  
|                 | Practitioners and policy-makers  
|                 | General public |

7.4.1.1. A Critical Literature Review on Behavioural Additionality as a Concept of Evaluation (Chapter 2)

The problem identification stage starts with natural choice. A critical literature review of behavioural additionality from the perspective of evaluation is presented in Chapter 2. This literature review starts with an exploration of the conceptual background that behavioural additionality was inherited and built on by first analysing the use of the concept of additionality in different contexts. The focus of this block is research methods, theories, and practices and applications but research findings of the literature that discussed these concepts *per se* are excluded. This section aims to build a bridge between the similar uses of the concept of

43 Taken from Cooper (1988)
additionality by only covering central and pivotal issues around concepts and methodologies. A second block in this literature review looks exhaustively at the historical development of behavioural additionality with the widest focus. The final block is the critique of this literature by which four different categories of understanding of behavioural additionality are identified. This block represents the critical discussion of the literature review on behavioural additionality as a concept of evaluation. The first major problem with the concept is identified as its lack of a unit of analysis. This chapter suggests the concept of organisational routines as the candidate for this purpose.

7.4.1.2. An Original Exploratory Quantitative Research on the Practice of Behavioural Additionality in Evaluation (Chapter 3)

Currently behavioural additionality’s foremost function is in the evaluation of innovation policy programmes. The use of the concept as a topic of evaluation should be understood in order to comprehend the potential practical problems arising from the issue of under-theoretisation identified in the previous block. Similarly, the concept’s relationship with other types of additionality as well as other evaluation characteristics should be understood. To this end, Chapter 3 utilises the INNO-Appraisal database of 172 EU25 national innovation policy measure (programme) evaluations. This database includes the basic characteristics of these evaluations such as the methods they used, the topics they covered, their quality and usefulness, etc. Behavioural additionality, input additionality and output additionality are the three topics out of 15 possible ones. This section of research conducts a basic statistical analysis by comparing the whole dataset to evaluations that covered behavioural additionality, input additionality and output additionality. In this way, not only can the basic characteristics of behavioural additionality evaluations be revealed but their difference from other additionality evaluations and all evaluations can also be identified. This section of research endorses the findings of Chapter 2 that the concept of behavioural additionality is under-utilised and misunderstood as it is under-theorised.

I have played a considerable role in designing, organising and building up the INNO-Appraisal database as part of my professional duties. Therefore, although this data has not been collected for the purpose of this research, it can still be considered as primary data. Similarly, I jointly conducted a small-scale study of behavioural additionality evaluations by mostly utilising the material produced in Chapter 3 as well as a number of qualitative case studies of selected behavioural additionality evaluations that are not used in Chapter 3. Therefore, not only I have not used any material that is exclusively produced by this project, but the material presented in Chapter 3 is also my exclusive and original work.
7.4.1.3. A Critical Literature Review on Behavioural Additionality as a Concept of Innovation Policy (Chapter 4)

This is another literature review of behavioural additionality from a policy-making perspective. Behavioural additionality has been in the core of evolutionary rationale for innovation policy whereas input and output additionality are the hallmark of the competing paradigm, the neoclassical approach. Therefore, this block of literature is reviewed with the focus on theories, the aim of linguistic bridge-building and criticism. The coverage in Chapter 4 is exhaustive (but only limited to the direct and primary literature) and it is organised conceptually. This literature review identifies the second major problem as the concept’s misalignment in terms of its framework of analysis and suggests that a more evolutionary approach should be adapted.

7.4.2. Tool Building

This second stage of the research consists of two chapters that review two concepts that help to answer the two main problems raised in the problem identification stage. Both these literature reviews are informative; they are not directly and obviously related with the concept in question. Thus, the aim is not to review these issues per se but to explore if they are relevant and potentially useful for the cause. The focus in these literature reviews is the underlying theories with the aim of developing a language to explain behavioural additionality later in the thesis. Furthermore, they are not exhaustive; only central and relevant pieces of literature are reviewed. Finally, they are organised according to their conceptual structure.

7.4.2.1. An Informative Literature Review on the Concept of Organisational Routine (Chapter 5)

This chapter analyses the concept of organisational routine as the foremost unit of analysis to study the change and stability of behaviour in organisations. The first section focuses on four different definitions of the concept before embracing one of them for further exploration. The following section discusses how this concept is used to explain change and stability in organisations, two dimensions relevant to behavioural additionality. Finally, scholarly literature on the operationalisation of the concept is also explored. This chapter concluded that the concept of organisational routine fits very well with the requirements of a new unit of analysis for behavioural additionality.

It must also be noted that parts of Chapter 5 appeared in a sole publication of the author (Gok, 2010).
7.4.2.2. An Informative Literature Review on the Evolutionary Approaches in Explaining Economic and Social Change (Chapter 6)

Chapter 6 analyses the evolutionary explanations for economic and social change. As discussed in Chapter 4, evolutionary explanations are the dominant paradigms for innovation policy and extremely relevant to behavioural additionality. The first section in this literature review looks at the general characteristics of this constellation of approaches. The second section discusses a particular evolutionary framework in which the economic evolution happens through the change of organisational routines at the micro, meso and macro levels. Not only does this framework provide an excellent opportunity to be utilised as a new framework of analysis for behavioural additionality but also it constitutes a direct and very relevant link to the problem of unit of analysis and its prospective solution.

Some issues covered in Chapter 4 are discussed again (albeit in much greater length) in Chapter 6 due to the shell design of the thesis. Chapter 4 covered issues only directly related with the concept of behavioural additionality whereas Chapter 6 scans the broader field with an open view.

7.4.3. Problem Solution

The problem solution stage of the research consists of two separate modules represented by two Chapters.

7.4.3.1. Theory Building Research to Devise a New Theory of Behavioural Additionality (Chapter 8)

The main aim of this chapter is to build a new theory of behavioural additionality. The chapter first starts with a summary of the problems and prospective solution as identified in the previous problem identification and tool building stages. Then a section is devoted to the implicit assumptions of behavioural additionality and their incompatibility with the concept of organisational routines and evolutionary approach. This section is located in the theory-building chapter rather than the problem identification stage as this discussion could be made only after articulating various issues about the problem and features of the prospective solutions. The next section defines behavioural additionality as the evolution of organisational routines within firm because of government intervention. Micro, meso and macro phases of behavioural additionality form the flow of the theory. Although arguments presented in this section are highly abstract and sometimes speculative, examples are used to clarify as much as possible. The final section of this chapter focuses on the implications of this new understanding of behavioural additionality including the issues of the possibility of behavioural additionality, the aims of it, and finally the conditions where it can be stable. This section constitutes the main discussion of the thesis.
7.4.3.2. Theory Illustration Research

7.4.3.2.1. Rationale

The final module within this thesis is devised to apply the new approach of behavioural additionality empirically. After devising a highly abstract and novel theory (as these concepts have never been used together for a similar aim), an empirical module could possibly be needed for three reasons (George and Bennett, 2005). Firstly, the theory developed could be tested against real life cases to show its relevance, applicability and effectiveness. Secondly, an empirical module could serve the theory-building purpose by feeding into the theory. Thirdly, an empirical module could be an illustration of the abstract theoretical propositions to provide a better understanding. This research addresses the first aim only partly, it does not address the second one at all, and fully applies the third.

The first aim of testing the theory developed by behavioural additionality could only be addressed partly because of several reasons. First, there are conceptual barriers for the testing of the theory. I will discuss in Chapter 8 that there are three phases of behavioural additionality: MicroBA, MesoBA and MacroBA. In particular, MacroBA represent a grand stage where any empirical testing would require a very long-term span as well as consideration of countless numerous factors that are relevant to macroeconomic evolution other than behavioural additionality.

Secondly, a full-scale testing of MicroBA and MesoBA would require a full-scale evaluation of a programme. This would be out of the scope of this thesis for three reasons. Firstly, a full-scale evaluation would require extensive consideration of the context and many other variables that would deviate from the focus of the thesis. Secondly, this would entail a very considerably higher degree of effort than PhD researchers could devote themselves. Finally, the costs involved would be very high.

The final reason for not including a full-scale testing in this research is operational. The theory developed throughout the thesis is believed to be an important leap forward. However, as it needs to focus its attention to the theoretical questions, it does not cover some of the operational aspects required for testing, such as the particulars of evaluation of behavioural additionality.

This research has not addressed the possible second aim of an empirical module that it could mainly feed into the theory developed. As discussed in Chapter 8, the theory is intended to be generic in the sense that it can be applied to a wide variety of contexts. However, deriving from a real-life case would be extremely difficult as the sensitive context conditions such as the structure of the national innovation system, the rationale for policy, and the modalities of the
programme would make external validity very problematic. Similarly, this would again require a full-scale evaluation that is not feasible for the reasons outlined above.

A final prospective purpose of an empirical research within this thesis would be illustration. The study fully addressed this by conducting two case studies in the form of plausibility probes. A plausibility probe is a type of case study that could be employed “to sharpen a hypothesis or theory, to refine the operationalisation or measurement of key variables, or to explore the suitability of a particular case as a vehicle for testing a theory before engaging in a costly and time-consuming research effort, whether that effort involves a major quantitative data collection project, extensive fieldwork, a large survey, or detailed archival work” (Levy, 2008: 6-7). They are “preliminary studies on relatively untested theories and hypotheses to determine whether more intensive and laborious testing is warranted” (George and Bennett, 2005: 75). As they demonstrate the essence relevance of the theory to real life cases, they are also called illustrative case studies (Levy, 2008).

7.4.3.2.2. Overall Design of the Empirical Application

In line with the aims discussed above, the research studies two different programmes to exemplify the phases, processes, and features of micro behavioural additionality as developed in the new theory. The aim of these case studies is to exemplify these issues in real life cases.

The programmes selected are the Turkish TUBITAK-TIDEB Programme and British Collaborative R&D Programme. Although the selection of particular programmes are not very critical to the cause of the thesis as the main aim is only for illustration, there are two different considerations for the selection. First, these particular programmes are selected on the basis of operational ease of conduct. I worked at the organisation that managed the first programme and I live in the country that the second programme is based. Secondly, as both programmes are classical grant programmes and examples of the most common type of innovation policy measures in Europe, their selection would represent a better opportunity to show that the theory is plausible for a considerable number of innovation policy programmes in Europe. Finally, as these programmes have been running for a long time without significant change in their structure, it is considered to be easier to conduct case studies on them. The research conducted case studies on both of them rather than picking up only one of them to increase the degree of internal validity.

The unit of analysis is the routine within individual firms supported by these programmes. As the aim is to illustrate behavioural additionality at the micro level only, the unit of analysis is confined to individual firms. The programme itself is not a unit of analysis as such. However, as the context conditions must be understood to comprehend behavioural additionality within the firm level,
programme characteristics will be discussed. The main aim of illustrating the phases, processes, and features of micro behavioural additionality will be maintained. The unit of analysis is analysed within the context of the project that influenced the routine, the firm that the routine belongs to, and finally the programme that the routine is influenced. Therefore, the nested hierarchy will be in the form of programme – firm – project – routine.

7.4.3.2.3. Selection of Individual Cases
As the main aim of the cases is to illustrate newly-theoretised micro behavioural additionality, diversity among these cases is given the utmost importance. Studying different kind of firms in different conditions would increase the chance to cover all of the issues that the theory considers. Similarly, this would represent a stress test in which different kinds of cases would increase the reliability of the test. Therefore, in the selection of cases, diversity in terms of the following characteristics was sought:

- **Size**: A balanced distribution between micro-sized, small-sized, medium-sized and large-sized firms is considered.
- **Openness**: Level of imports and exports is thought to be important characteristic to distinguish different types of firms.
- **Technology Intensiveness**: Level of technology used in the business is assumed to be important. Representation for all low, medium and high technology firms is sought.
- **R&D Experience**: Diversity among different levels of R&D experience is considered. First-time R&D, occasional R&D and frequent R&D performers are perceived as important to be included in the study to stress test the model as in some cases ‘origination’ of routines would be important while in others ‘adoption’ and ‘retention’ would gain significance.
- **Innovation type**: Investigating firms performing product or process innovation would yield different perspectives in the research.
- **Location**: Finally, the physical location of the firms would be important for the selection of the firms considering the logistics as well as their high exposure to endemic innovation conditions.

A preliminary list of firms to study was formed. For the TUBITAK-TIDEB programme, the author had access to the project finalisation report (AGY350) which allows a data mining exercise. For the British Collaborative R&D Programme, the public database of project names and one-page synopses were used. In both cases, the preliminary list of around 50 firms for each programme was discussed with respective programme managers. Out of 50 firms in each programme, the respective programme managers contacted around 25 of them on behalf of the author. 6 firms in TUBITAK-TIDEB programme and 3 firms in the Collaborative R&D Programme were selected.
As the data collected was considered enough to accomplish the illustration aim of this module of the research, no further effort to include more cases was deemed necessary.

A pilot study with Componenta Doktas was conducted. This utilised an interview with the project officer in the funding organisation, a document search and finally a 4 hour face-to-face interview with the project manager at the firm. The interview was semi-structured and intended to listen to the firm’s story while focusing on the behavioural changes. All such changes were investigated if they would have been the case without the intervention and if so how different they would be. This pilot case was successful in terms of providing feedback to the interview template, which is presented in this chapter’s Annex.

The interview template is designed around a preliminary framework of micro behavioural additionality. The framework shares the same fundamental principles laid out in Chapter 8 while some of the details are different as it is prepared at an earlier stage of the research. For example, the main phases of micro behavioural additionality are now called origination, adoption and retention while the interview template calls them variation, selection and retention. Furthermore, the interview guide represents a repository of all the possible questions that could be asked to wide variety of people within the firms with a view that it might be possible to interview different functions within them. However, in most cases, it proved difficult to interview more than two people.

To be able to use the time effectively and unfold critical issues, interviews used a gradual narrowing down strategy. The pilot case has proved that it is very difficult to focus directly on organisational routines right from the beginning of the interview. Therefore, the interview guide is designed to focus on the broad issue of performance (the achievements of the project) first. This enabled the firms to reflect on their capabilities (how they achieved their objectives). Consequently, it was possible to focus on activities they performed to be able to realise these performances. Finally, all these enabled firms to think about their routines (tasks they performed to accomplish these activities and how they performed them). A previous version of the framework is included in the firm to be able to convey the main principles of the research to the firms. This approach will be discussed in detail later on in Chapter 9.

After this pilot, full-scale semi-structured interviews were conducted with the rest of the firms. All interviews were conducted face-to-face and different people within firms were engaged as much as possible. This was not possible in some cases, especially in small and micro firms where projects were managed by a sole person or in cases where the complex organisation of large firms, discontinuity and sensitive political conditions were in place for larger firms. Finally, project officers were interviewed for the TUBITAK-TIDEB programme while this was not possible for Collaborative the R&D Programme because, in some of the firms supported by the latter, the
firm and/or programme manager refused to grant access to the project documents and thus interviews were the only source of data.
Part II

Chapter 8: A New Understanding of Behavioural Additionality
8.1. Introduction

In this chapter, I will attempt to pull the themes together. Part I of the thesis analysed the current state of behavioural additionality from different angles and uses. It was concluded in Part I that behavioural additionality needs a better unit of analysis as well as a new framework of analysis. Two proposed conceptual frameworks to answer this call, organisational routines and the evolutionary approach, were analysed and deemed fit for purpose. This chapter will now operationalise these frameworks to address the deficiencies of the current understanding of behavioural additionality. By doing so, I aim to suggest a new evolutionary approach to innovation policy evaluation.

Section 8.2 will first take stock of the issues discussed in Part I of the thesis. In Section 8.3, the problem will be substantiated by outlining the implicit assumptions of the concept and their incompatibility with an evolutionary understanding. Section 8.4 puts forward a set of principles for the general framework of the new understanding of behavioural additionality, which is then discussed in Section 8.5. Sections 8.6, 8.7, and 8.8 will explore the micro, meso and macro levels of behavioural additionality. Section 8.9 will discuss the implications of the new understanding and finally the conclusion is presented in Section 8.10.

8.2. The Need for a New Understanding

In Part I of this thesis, I have analysed the current understanding of behaviour additionality in the evaluation literature and practice within policy discussion. In Chapter 2, I have also discussed the genesis of the concept of additionality and its relation to the mainstream evaluation literature. I identified four broad categories of definitions of behavioural additionality:

A) An extension to input and output additionality covering scale, scope and acceleration additionalities and like

B) The change in the non-persistent behaviour related to R&D and innovation activities

C) The change in the persistent behaviour related to R&D and innovation activities

D) The change in the general conduct of the firm with reference to the building blocks of behaviour

In Chapter 2, it was also revealed that there is a consensus in the literature that the evaluation framework of the input-output paradigm treating the firm as a black-box is misleading and incomplete. Without any exception, these studies also propose that evaluation should take into consideration what is inside the black-box. Some of these studies implicitly criticise the neoclassical approach that favours the ease of evaluation over a complete understanding of the effects of policy. Their shared proposal is to evaluate behavioural additionality in order to grasp
Part II Chapter 8: A New Understanding of Behavioural Additionality

all of the impacts a policy creates. However, the way these studies try to evaluate behavioural additionality fundamentally relies on the same logic. Scholarly literature on behavioural additionality, which criticise the black-box logic of the neoclassical approach, treats behavioural additionality in an input-output framework. These studies successfully open the black-box of the firm and discover smaller black-boxes of ‘behaviour’. Then, these smaller black-boxes of behaviour are evaluated by their own input and outputs. In other words, the literature treats ‘behaviour’ per se as a unit of analysis and evaluates it with its inputs and outputs. However, ‘behaviour’ per se is not a unit of analysis, as it has no conceptual background in economics, management science, or organisational science literatures. Therefore, although some parts of the literature include vague references to building blocks of behaviour (such as organisational routines), the behavioural additionality literature fundamentally fails to identify and use a proper unit of analysis.

Chapter 3 looked at the use of the concept of behavioural additionality in the practice of evaluation by analysing the 172 national innovation policy evaluations from across EU25 countries. The results endorsed the main finding above: the categorisation of different definitions of behavioural additionality in the practice of evaluation is more or less similar to that of scholarly literature and none of these four categories is dominant in terms of the number of evaluations that employed them. Similarly, as the practice of behavioural additionality evaluation suffers from the lack of a proper unit of analysis (and thus the concept is ambiguously defined), there is no common ground as to how behavioural additionality is understood by evaluators and policy-makers alike. Finally, Chapter 3 statistically outlined the technical differences (in terms of methods, topics, quality and usefulness, etc.) among evaluations that cover behavioural additionality, other kinds of additionality evaluations, and the ones that do not cover any kind of additionality. It reveals that while these three kinds of additionality evaluations are different from other kinds of evaluations, behavioural additionality evaluation is also different from input and output additionality evaluations. Behavioural additionality evaluations are not significantly method biased and of more quality or usefulness than other evaluations due to under-theoretisation discussed in Chapter 3. This, in turn, contributes to an under-appreciation of the effects behavioural additionality is supposed to evaluate, and ultimately an under-investment in innovation by governments (Aho et al., 2006; Georghiou, 2007).

Chapter 4 approached the issue of behavioural additionality from the angle of policy rationale. The discussion concluded that input and output additionality are at the heart of neoclassical rationale for innovation policy while behavioural additionality is the hallmark of an evolutionary / structuralist innovation policy. However, as also established in Chapter 2 and 3, the current understanding and practice of behavioural additionality use ‘comparative statics’, which is the
framework of analysis of neoclassical economics. It was also concluded that ‘dynamics’, the framework of analysis of evolutionary approach, should be used instead to be able to align itself better with this camp. Therefore, behavioural additionality also needs a new framework of analysis.

The most plausible answer to these two appeals appears to be obvious in the evolutionary economics literature: to use organisational routines and an evolutionary approach as a unit and framework of analysis for behavioural additionality. To do this, one needs to understand (or at least run through) these two concepts. Chapter 5 and 6 accomplished this aim. The former chapter reviewed the organisational routines literature and discussed four different understandings of the concept before embracing Pentland and Feldman (2005, 2008) definition of routines. Chapter 5 also discussed the role of routines in providing stability and guiding change in organisations. Chapter 6 looked at the evolutionary economics literature by firstly reviewing the common features of evolutionary explanations and then by putting a particular framework under the microscope (Dopfer et al., 2004; Dopfer and Potts, 2004, 2008, 2009). Chapter 6 also discussed how economic evolution occurs through routines in micro, meso and macro levels.

To re-cap, here is the open question posed in Part I:

- How can we redefine behavioural additionality by employing organisational routines as the unit of analysis and the evolutionary approach as the framework of analysis?

8.3. The Challenges of the Current Understanding of Behavioural Additionality

8.3.1. Assumptions of the Current Understanding

As established in Chapter 2 and Chapter 3, one of the most important consequences of not having a sound theoretical basis for the concept of behavioural additionality is that the current understanding relies on very strong and critically implicit assumptions. A lack of analytical depth is balanced with the convenience of making fundamental and implicit assumptions so that the concept becomes more useful for evaluation and the analysis of policies. These assumptions are fully investigated in this section to understand what exactly is wrong with the concept in analytical terms. This will feed into the development of a new understanding by better aligning the concept of behavioural additionality with the evolutionary framework of analysis and also embracing the concept of organisational routines as the unit of analysis.
8.3.1.1. Clear Boundaries

Behavioural additionality operates within the boundaries of the firms that the policy targets. In most cases, the change of behaviour in a particular firm is the most important issue if not the sole one. The interactions between the direct and indirect beneficiaries, i.e. other firms with which beneficiaries are in collaboration, other constituent institutions of the innovation system and finally the public organisation that runs the programme are often neglected or at least underestimated. As I discussed in Chapter 2, this issue is recognised even by the mainstream economic policy evaluation and the HM Treasury publications (English Partnerships, 2004, 2008; HM Treasury, 2003) provide a method to take the spill-over effects into consideration.

8.3.1.2. Isolated Behaviour

In most cases, the focus is on a particular kind of behaviour that is considered to be ‘conducive’ to an ultimate policy objective (e.g. innovativeness). This particular behaviour is analysed in isolation from other behaviour. For instance, if the aim of the evaluation is to understand the collaboration behaviour, the relationship between this and other types of behaviour is not considered and collaboration is assumed to be practised independently from the other behaviour of the firm. Furthermore, in most cases, only one form of a particular behaviour is considered and all the other possibilities are neglected. Carrying out the collaboration behaviour example, the focus of some studies is the R&D collaboration between the firms supported by the programme while, for instance, they ignore marketing collaboration that might lead to an increase in the innovativeness as well.

8.3.1.3. Black Box of Behaviour

As outlined above and discussed in Chapter 2 in detail, behavioural additionality studies and the literature in general criticise the input-output approach by claiming that it treats the firm as a black-box that takes some inputs and creates some outputs, neglecting the process within which this happens. However, the very same approach is mostly repeated in the current conception of behaviour additionality. The literature successfully opens the black-box of the firm and discovers smaller black-boxes of behaviour. Consequently, these smaller black-boxes are analysed in terms of their inputs and outputs and therefore treated as black-boxes as depicted in Exhibit 17. For example, a significant portion of behavioural additionality studies argue that innovation spending and various consequent outputs are not enough to assess the true contribution of the government intervention. They suggest focusing on R&D collaboration behaviour, for instance, as something conducive to competitiveness as much as devoting more resources for it. However, the way they analyse ‘the R&D collaboration behaviour’ is to measure the change in the

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44 The only exception to this is Autio and his colleagues’ (2008) study in which they focus on what they call “second order additionality”.

‘resources’ devoted to collaboration (e.g. money spent in collaborative projects) and the increase in the ‘amount’ of collaboration itself (e.g. number of partners). Nevertheless, they fail to open the black-box of collaboration by focusing on the change in the dynamics of the collaboration or the building blocks that create collaboration behaviour.

Exhibit 17: Black-Box Logic of Input-Output and Current Behavioural Additionality Analysis

8.3.1.4. Additivity of Behaviour

Different behavioural additionality created within individual firms are ‘completely additive\(^{45}\) and aggregate indicators of behavioural additionality for the programme/policy can therefore be derived. For example, the number of firms that collaborate more as they are supported than they would have otherwise done so can be summed and the grand total would be equal to the behavioural additionality.

8.3.1.5. Conduciveness of Certain Behaviour

As hinted earlier in this chapter, often evaluations and scholarly literature assume certain behaviour are conducive to ultimate objectives of a programme such as innovativeness or competitiveness. This assumption sometimes relies on empirical studies or personal experience. However, the link between the particular behaviour and the ultimate policy objective is not

\(^{45}\) Completely additive refers to the mathematical term for the additive function \(f(n)\) where \(f(ab) = f(a) + f(b)\). The analogy here is that most of the literature and the practice assume that the behaviour created in the firm level can be completely summed up to find the aggregate effect of the programme.
analysed or even explained in any of the studies. For example, studies that crudely assume that collaboration is conducive to competitiveness fail to explain the nature of the link between the two. This assumption, in a way, is very similar to the simpler assumption of clear input-output linkages in most of the input additionality studies. In fact, this issue is not limited to the additionality evaluations but it is inherent in the wider field of science, technology and innovation policy evaluation. For instance, European Court of Auditors report on the evaluation of the EU Framework Programmes (FPs) argues that FPs often lack an explicit intervention logic and hence evaluations of FPs are often implicitly forced to make critical assumptions which ultimately decreases the quality and usefulness of evaluations (European Court of Auditors, 2007).

I will now analyse all these assumptions in the light of the features of the evolutionary approach to explain economic and social change as discussed in Chapter 6. I have already concluded in Chapter 3 that the current understanding of the concept of behavioural additionality is not compatible with the evolutionary approach. This analysis might shed more light to reveal what exactly the problem is.

### 8.3.2. Incompatibility of the Current Understanding of Behavioural Additionality with the Evolutionary Approach

Having discussed the issues that the current understanding of behavioural additionality has taken for granted, attention should now turn to understanding why and how these assumptions undermine the concept. The focus here will be the incompatibility of these assumptions with the evolutionary framework of analysis. This discussion is summarised in Table 16.

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Explanation</th>
<th>Incompatibility with the Evolutionary Approach Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>clear firm boundaries</td>
<td>Behavioural additionality operates within an isolated firm</td>
<td>dynamics first</td>
</tr>
<tr>
<td>Isolated behaviour</td>
<td>Particular behaviour is isolated within the firm</td>
<td>heterogeneous agents</td>
</tr>
<tr>
<td>Black-box of behaviour</td>
<td>Behaviour is a black-box that takes inputs and created outputs</td>
<td>population thinking</td>
</tr>
<tr>
<td>Additivity of behaviour</td>
<td>Behavioural additionalities of different firms can be added together</td>
<td>dynamics first</td>
</tr>
<tr>
<td>Conduciveness of certain behaviour</td>
<td>Certain behaviour are better for ultimate policy objectives</td>
<td>heterogeneous agents</td>
</tr>
</tbody>
</table>

Table 16: Compatibility of the Assumptions of Behavioural Additionality with the Evolutionary Approach
8.3.2.1. Dynamics First!

I have discussed in Chapter 6 that the foremost concern of the evolutionary approach is the dynamics in the sense that it asks the quality question (why and how has something happened?) or the issue of becoming rather than and in addition to the quantity question (if and how much has something happened?) or the issue of being. It is now clear that all of the five assumptions discussed above are incompatible with this feature. For the first two assumptions (Sections 8.3.1.1 and 8.3.1.2 above), regarding the behaviour under evaluation and the firm which carries that behaviour are disconnected from their environment and their counterparts, the analysis is patently far from capturing the systemic context and dynamics of the issue. Any analysis that ignores that kind of dynamics or does not do justice to its importance is a static analysis that considers issues under isolation and is ultimately far from being compatible with the wider requirements of policy-making by considering the innovation system. Furthermore, not only does this kind of static analysis (comparative static analysis, in fact, as discussed in Chapter 4 and 6 in detail) fail to reveal the systemic nature of the issue by examining the relationship between various analytical levels but it also lacks the necessary analytical power to “keep track of whole sequence of changes, which may extend over long periods of time” (Witt, 2005: 394). This is a failure in terms of the evaluation of the long-term impacts that behavioural additionality aspires to provide.

Secondly, the assumption of the current understanding of the concept of behavioural additionality that behaviour is a black-box (Section 8.3.1.3 above) is also incompatible with the ‘dynamics first!’ feature of the evolutionary approach. The current understanding analyses behaviour only in terms of the resources devoted for it as well as the outputs of behaviour. Therefore, it ignores the dynamics of the change itself. In the example of collaboration, most often the black-box assumption would mean the following dynamics are disregarded:

- Patterns of collaboration (i.e. if the firm collaborated differently, with some other firm that it would not have done without support).
- Rate and trend of collaboration (i.e. if the changed collaboration is a persistent one, if the government intervention triggers an ever increasing collaboration or it will gradually decrease some time after the intervention and so on)
- Internal dynamics of collaboration (if the collaboration is extended to other parts of the firm because of the government intervention)

Some of the more recent literature considers the issue of behavioural additionality in terms of more fundamental concepts of organisational science. For instance, Clarysse et al. (2009) define
behavioural additionality in terms of three different kinds of organisational learning: experiential, congenital and inter-organizational learning. They associate and explain only the first kind of learning with the building blocks (i.e. organisational routines) and discuss all three kinds of learning in terms of the behavioural additionality they could generate. While they apply this approach to an empirical case, they use the following indicators for the three kinds of learning:

- Experiential learning: the number of projects that were financed by the governmental agency at the specific firm
- Congenital learning: R&D expenditures as a percentage of the turnover
- Inter-organisational learning: the number of other organisations involved in the projects

Although the idea of understanding behavioural additionality in terms of the fundamental concepts of the organisational science and thus trying to open the black-box of the firm is a leap forward, the application is undermined with the very same mistake that the rest of the behavioural additionality as well as the input-output additionality literatures commit. They classify behaviour in terms of the process by which these behaviour are acquired (learning) but then fail to comprehend the inner dynamics of it and analyse behaviour in terms of its input and output. The indicators they use for experiential and congenital learning are clearly the inputs of (any) firm behaviour whereas the one for inter-organisational learning is an output.

The fourth assumption (Section 8.3.1.4 above) that the behaviour is additive is fundamentally a contradiction to the 'dynamics first!' principle of the evolutionary approach. This assumption also implies an understanding based on input and outputs. Indeed, what is added is not the dynamics (or an indicator of dynamics) but the inputs or outputs of behaviour in particular firms.

Finally, the fifth assumption (Section 8.3.1.5 above) that there exists a finite set of list of conducive behaviour to an ultimate policy goal clearly ignores the dynamics as the majority of the literature (like the rest of the evaluation studies often does) fails to explain the relationship between the certain type of behaviour and policy objective (and intervention logic).

8.3.2.2. Heterogeneous Agents

As I have discussed in Chapter 6, the evolutionary approach does not consider that all agents are similar. On the contrary, the heterogeneity of agents is one of the main tenets of this camp. However, the implicit assumption of the behavioural additionality literature that behaviour is additive (Section 8.3.1.4 above) is fundamentally incompatible with this view. To be able to assume that agents' behaviour or any other proxy to it can be summed up to reach an aggregate behavioural change proxy or indicator, one needs to treat all the carriers of these behaviour as the same. In a similar vein, the assumption that there exist clear firm boundaries (Section 8.3.1.1
above) requires thinking in line of the homogenous agents, which makes it incompatible with the heterogeneous agents tenet of the evolutionary view.

**8.3.2.3. Bounded Rationality**

Bounded rationality a la Simon (1982) as embraced by the evolutionary approach asserts that the cognitive capabilities of the agents are limited just like their physical resources and therefore they cannot consistently act rationally. This gives way to learning in the evolutionary sense. This feature, therefore, is incompatible with the black-box of behaviour assumption (Section 8.3.1.3 above) as under the bounded rationality feature of the evolutionary approach, agents do not demonstrate the same behaviour on the face of same constraints (i.e. same input and outputs for their behaviour). Similarly, this would also lead to the collapse of the additivity of the behaviour assumption (Section 8.3.1.4 above).

**8.3.2.4. Population Thinking**

Population thinking is arguably the foremost tenet of the evolutionary approach. This involves thinking in terms of the frequencies of different types of objects rather than uniformities. The objects within an evolutionary analysis interact closely and together constitute a system. Therefore, it is not possible to think of these objects (or units of analysis) in isolation as the current practice of the behavioural additionality does so by assuming clear firm boundaries and isolated behaviour (Section 8.3.1.1 and Section 8.3.1.2 above). Furthermore, this perspective is clearly a contradiction to the additivity of behaviour assumption (Section 8.3.1.4 above) of the behavioural additionality literature as the whole is different (often greater) than the sum of its constituents from the population thinking perspective. I will discuss this point in detail while introducing a meso level to behavioural additionality later in this chapter.

**8.3.2.5. Micro-Foundations, Learning and Routines**

It was noted in Chapter 6 that the evolutionary approach includes a micro-foundation in which how and why agents behave in a certain fashion is explained. This is mostly done by employing the concept of organisational routines especially in learning mechanisms. It is clear that the black-box of behaviour assumption (Section 8.3.1.3 above) of the current theoreatisation of behavioural additionality contradicts this principle by only considering the inputs and outputs of certain behaviour and thus failing to explain (or at least focus on) why and how certain behaviour are practised.

**8.4. The Approach**

To provide a new understanding for behavioural additionality, I will first discuss and agree on the appropriate approach. The approach to be used to develop a new understanding of behavioural
additionality must be generic and context independent whereas it must also be flexible (i.e. adjustable to different contexts) and as simple as possible. The generic nature of the explanation will rely on the following three principles.

8.4.1. Behaviour Generic

The approach will be generic concerning the type of behaviour that the government action creates behavioural additionality. As established in Chapter 2 and above in this Chapter, some scholars explicitly or implicitly perceive behavioural additionality as the change in the behaviour that is conducive to whatever is assumed to be positively influenced by government action (productivity, innovativeness, competitiveness, etc.). This implies that these ‘conducive behaviour’ form a finite list that can be derived by the government from experience and/or empirical scholarly literature. This list of behaviour in most cases forms a basis for the policy rationale. For example, by deriving from experience and the empirical literature, government assumes that cooperation between firms is conducive to innovativeness and therefore should be supported. In a similar vein, Georghiou and Clarysse (2006) try to categorise these ‘conducive behaviour’ that the pilot studies at the OECD project assumes to be conducive. I should note here that, a more abstract reasoning that is independent of that kind of a definitive list of behaviour would be more appropriate as the approach developed here must be generic and applicable to a wide variety of contexts.

8.4.2. Mechanism Generic

The approach will be generic concerning the particular mechanism through which the government action creates behavioural additionality. The government intervention can take many different forms and within each of these forms, there can be a variety of modalities. Some of these forms involve financial interventions such as grants, loans and tax credits but there can also be non-financial interventions. A grant, furthermore, can be run in a set of different modalities. The approach of this thesis will be mechanism generic in the sense that with small adjustments, the understanding developed here can be applied to any kind of mechanisms and modalities. However, it should also be noted that the thesis has a focus in terms of a mechanism (but not modality) – direct innovation subsidies in the form of grants to private firms. In Chapter 9, the illustration of the theory developed here will build on that kind of a programme.

8.4.3. Analysis Generic

As discussed in Chapter 6, the mode of analysis of the evolutionary economics as crystallized by Dopfer and Potts (Dopfer et al. (2004) and Dopfer and Potts (2004, 2008, 2009)) is generic. This involves the study of coordination and change of generic routines rather than the study of
allocation of scarce resources under rational choices of the neoclassical theory. Similarly, the analytical mode here will be complexity and evolution rather than simple equilibrium.

8.5. The General Framework

Having discussed the challenges of the current status of the concept of behavioural additionality, it is now clear that a new approach is evidently necessary. Up until now, I have argued that the new approach must (i) not take the above-discussed issues granted, (ii) thus adopt a more evolutionary approach (iii) and finally utilise the sound unit analysis of organisational routines. This sub-section will outline the general framework in which behavioural additionality operates as depicted in Exhibit 18.

The general framework of the new approach to behavioural additionality consists of three layers of micro, meso and macro. Each of these layers will be discussed in the following sections in this chapter, but will be briefly introduced here first. As I have discussed in Chapter 2, not surprisingly, behavioural additionality has mainly been a micro concept just as the main focus of neoclassical economics is micro. It is understood as a change of the behaviour of a particular firm. In some cases, these micro changes were added up to approximate the effect at the programme level but the unit of analysis has always been confined to the boundaries of the firm. I will start exploring behavioural additionality from this conventional point as well: a micro level of behavioural additionality where the unit of analysis is a particular organisational routine within a particular firm will be discussed. However, I will also add an evolutionary flavour to grasp the dynamics of the issue.

The second level is the meso level of behavioural additionality, which the current understanding fails to address. As I have discussed above, the implicit assumptions of the current understanding, that there are clear firm boundaries, and behaviour can be analysed in isolation and finally behaviour is additive, make the concept incompatible with population thinking. However, population thinking must be one of the key features of behavioural additionality. The framework I develop includes it in the meso level of the concept. As I will discuss later in this chapter, the unit of analysis in meso behavioural additionality is the population of routines (and their carriers) within a programme portfolio.

Finally, a macro level of behavioural additionality will be introduced. Although there have been some weak attempts to econometrically link behavioural additionality with macroeconomic change (Suzuki and Yumitori, 2006), behavioural additionality has never been truly considered on the macro scale. The concept has always been considered as being overly complicated to comprehend at this level and convenience of the classical excuse of ‘too difficult to evaluate’ has been sought. However, behavioural additionality does have a macro level and this level bears a
crucial importance to a degree, as in the absence of a long-term macro behavioural additionality, the whole rationale of the government support becomes obsolete. At this level, the unit of analysis will be institutions in the sense of widely accepted and institutionalised routines or social technologies in Nelsonian terminology (Nelson, 1991, 2005, 2009a; Nelson and Sampat, 2001).

Within each level, I will first discuss the corresponding framework in which I identify the unit of analysis and the general features. This will be followed by a discussion of certain phases of evolution. For micro, for instance, I will discuss the processes of origination, adaption and retention of organisational routines due to government intervention. The concern in all these will not be at the operational level, but mostly the change in the trajectory will be discussed. The penultimate section will explore the rationale for behavioural additionality. Finally, the linkages between the three levels of behavioural additionality will be discussed.

Exhibit 18: The General Framework

8.6. Micro Level Dynamics of Behavioural Additionality

8.6.1. The Framework

Behavioural additionality begins at the micro level. Here, the concern is a particular firm that the government supports. This support changes particular routines within this firm. Therefore, the unit of analysis is a particular organisational routine (or group of particular organisational
routines) within a particular firm at the micro level. In other words, the interactor is the firm and the replicator is the routine.

There are three phases of micro level behavioural additionality in line with the three phases of microevolution as discussed in Chapter 6: a routine is originated, adopted and retained because of the government action. The following sub-sections will discuss these three phases. This is also summarised in Exhibit 19.

8.6.2. MicroBA I: Origination of an Organisational Routine in a Firm by Public Intervention

This is the phase where an organisational routine is created during the course of a government intervention. The government intervention can result in origination of new organisational routines through the following processes: creation of routines out of blue, mutation of existing routines, recombination of them and finally migration/diffusion.

8.6.2.1. MicroBA Ia: Creation

As part of the project financed by the government intervention, the firm starts doing something it normally does not do. By this process, a new routine is created. As I have discussed in Chapter 5, a routine is a recurrent pattern. Therefore, a task that is performed only once cannot be considered as a routine and similarly a task that is created by the government intervention but performed only once cannot be defined as behavioural additionality. As I will discuss later on in this section, all three aspects of routines should be in place to be able to classify a task as a routine and one of the conditions of this is that it has a performative dimension created by its performance a sufficient number of times.

I have discussed the three order of routines in Chapter 6 whereby 0th order routines are for higher routines such as the rule of law, 1st order routines are operational ones and finally 2nd order routines are routines to change 1st order routines. The process of the creation of routines by government intervention might concern either a 1st or 2nd order routine. I exclude the 0th order here, as the firm cannot control its 0th order routines; they are given and rather stationary in the short and medium term. In any case, creation itself is governed by a 2nd order routine (or a set of 2nd order routines). Firms with better 2nd order routines would have more absorptive capacity a la Szulanski (1996) and therefore would be more fertile for behavioural additionality.

If the project would not have been implemented in the absence of public support (i.e. there is project additionality), any routine created would fall into this category. Otherwise, the creation of routines would reflect the difference in the way the project is implemented because it is supported publicly. An example for the creation of such a 1st order operational routine might be
a firm introducing project management techniques or a new and radical production method for
the first time. Similarly, a case where there is creation of a 2nd order routine because of
government support might be a manufacturing firm that starts doing a proper academic literature
review in an R&D project to establish new procedures to increase productivity.

8.6.2.2. MicroBA Ib: Mutation

A second process of origination of a new routine by the government action is mutation. This
involves a change in existing routines because of the support. As I have discussed in Chapter 5,
the classical drivers of mutation are imperfect replication, tacit knowledge, creativity, and chance
and error. The government intervention might work with these drivers as well as running
alongside them.

I will start with the obvious effect where government intervention mutates a routine because of
its modality. In this case, mutation is exclusively attributable to the government intervention and
thus there is behavioural additionality. An example to this might be a firm that changes its
monthly financial statement production routine, as the government intervention requires a
particular report format.

Secondly, government intervention might influence the classical drivers of mutation. Mutation can
occur as some routines are replicated imperfectly. For instance, a firm can hire a new employee
with the intervention resources. When this employee practices a routine imperfectly or in a
creatively different way, this routine can change. Similarly, when another employee leaves the
firm, tacit knowledge he/she possesses about this routine is lost, the ostensive aspect of the
routine changes and thus the routine mutates. The government intervention might force or
prevent any of these to happen or change their structure.

8.6.2.3. MicroBA Ic: Recombination

The third process of origination is recombination. Bigger routines include a series of small
routines. A change in the sequence of these small routines originates a new routine. For instance,
an R&D project might result in a change in the sequence of a production routine and therefore
origination of a new routine by recombination. Government intervention might force the firm to
this specific sequence and therefore create behavioural additionality.

8.6.2.4. MicroBA Id: Migration/Diffusion

The final process of origination of new routines is migration/diffusion. The modern firm is a
complex organisation with several different organisational units and various combinations of
people working in these. These units often perform similar functions and therefore practice same
or similar routines. Government intervention might force the firm to originate a new routine by
migrating an existing routine from another unit within the firm. For example, the government intervention might require a specific kind of reporting standard that forces the firm to bring together a team consisting of people from accounting and R&D departments. As a consequence, a specific type of formatting that the accounting department practices diffuses to the R&D department. This could be behavioural additionality.

8.6.2.5. **Features of MicroBA I**

Here I will discuss two more issues that overarch the above processes of origination of a routine by government intervention.

The first clarification should be concerning how these processes can be initiated. Following the footsteps of Greve (2008) and the performance feedback theory, there can be three different kinds of search processes.

- **Problemistic search:** I will discuss the hypothetical case where a firm decides to undertake an R&D project to solve a particular problem as it thinks the perceived performance is lower than the aspiration level in a given task. It ends up with a set of solutions to close the gap, selects one of them, and by doing so creates a new routine. Prior to funding, government intervention might influence this comparison to convince the firm that a problem exists. For example, the support programme’s publicity might make the firm aware of a more productive way (i.e. lean manufacturing, etc.). Once the funding starts, the intervention might influence the perceived performance (i.e. firm might think it performs better or worse after its interaction with the project officer) and the aspiration level on a particular task (i.e. similarly the firm thinks it should perform even better). This leads to a change in the level of the perceived performance gap and therefore might initiate or change the problemistic search process. After the end of the project, a solution (or a set of alternative solutions) to the initial problem is implemented if the firm assesses the risks and broader context positively. Here, the government intervention might influence the decision whether the firm should implement a solution and if so which one the firm should choose to remedy the perceived problem. Finally, this solution involves a change in routines by triggering one of the above-discussed processes.

- **Slack search:** The second possible trigger is slack resources that are used to initiate a search process to increase the firm performance. The public resources granted might influence the degree to which the amount of these slacks would pass the critical mass.

- **Institutionalised search:** Finally, a search process can be initiated by purpose functioning units within the firm. The duty of the R&D department is to find new ways to increase the firm’s performance (by product and process innovations). Similarly, sometimes this
function is practised by the whole firm rather than a specific department. Government intervention might trigger this search process by encouraging the firm to build these kinds of institutionalised search processes by originating new or better units or new or better 2nd order routines.

Secondly, as I have discussed in Chapter 5, an organisational routine has three aspects: ostensive (cognitive and abstract aspect of the routine stored in people's 'mind'), performative (enactment of the ostensive part in particular time-space) and artefact (e.g. physical manifestations). This has the following implication for the cause here. The above-discussed process must encompass all these three aspects together. The government support must make all these three aspects possible so that it can be classified as behavioural additionality through the origination of new routines. I can discuss three relevant examples. Firstly, if the government support creates only a written procedure that no one in the firm understands/knows/shares and therefore no one practises it, this means that the government support only creates an artefact and thus the change is short of creating ostensive and performative aspects of a routine. This kind of a change cannot be classified as behavioural additionality. In another example, if the government intervention produces an ostensive aspect of a routine (i.e. change the cognition of the people involved in a certain task) but not create any kind of real concrete change (i.e. no change in the performative aspect), this cannot be considered as behavioural additionality. Thirdly, acquisition of machinery because of government intervention would not classify as behavioural additionality as it only represents a change in the artefact dimension and does not automatically bring a change in the ostensive and performative dimensions. In all these examples, one or two aspects of an organisational routine are missing and thus they do not meet the definition of behavioural additionality. I will discuss how this also relates to the second phase of behavioural additionality.

8.6.3. MicroBA II: Adoption of an Organisational Routine in a Firm by Public Intervention

As I have discussed in Chapter 6, the second phase of microevolution is the adoption of organisational routines. Most often organisational routines originated within the firm do not survive after the initial phase – some organisational routines created are practised in a limited fashion and then leave the collective repository of the firm. Generally, they lose one or more of their aspects. For example, when a new machinery (artefact) is bought in the firm, it results in a change in the cognition of the people who use it and also the concrete practice of the task; it therefore forms an organisational routine. However, if the machinery is returned (because it is found counter-productive or transferred to another unit or for any other reason), then the artefact aspect of the associated organisational routine becomes obsolete which means the routine dies. As I have discussed in Chapter 5, the processual nature of routines makes the speed...
of decay of an organisational routine critical. MicroBA II is the phase where routines originated in MicroBA I are selected.

This general framework might yield behavioural additionality in two ways. Firstly, government intervention might create behavioural additionality by stopping or reversing the process of decay of an organisational routine. In other words, it might help a routine, which would decay had there been no intervention, to be adopted. Routines are triggered by actors within a firm or by external cues. Government intervention might convince actors to continue triggering a particular routine by reinforcing any three aspects of organisational routine. It might create an artefact that would not have been created otherwise (a written procedure, a machinery, etc.), and/or enforce ostensive and performative aspects. Intervention might also act as an external cue and indirectly reinforce the routine (forcing firm to practise a routine one more time might make a critical difference). This first kind is an entry point for behavioural additionality: it operates in an already existing organisational routine.

Secondly, the process of adoption might apply to organisational routines that originate from MicroBA I due to government intervention. Very often, projects span a considerably long time and those routines that are originated in the course of a project might decay before the project ends. If the role of government intervention goes beyond MicroBA I and carries a routine to MicroBA II, then one can talk about the issue of persistence here. This type of behavioural additionality is more persistent and also influences the selection process within a firm. Once again, this is also related to the three aspects of organisational routines. The more integrated these three aspects to each other are, the more established they are; and the more persistent the routine is, the better the adoption process is.

Adoption of a routine also depends on the efficiency and effectiveness of 2nd order routines that originates these as per their absorptive capacity (Szulanski, 1996) as also discussed in MicroBA I above. Therefore, if the government intervention leads to the adoption of a 2nd order routine, this would have wider consequences in terms of behavioural additionality as one can then talk about a chain reaction.

Another issue in MicroBA II is related to organisational routine complexes. Routines work alongside other routines and a set of smaller routines constitute larger routines. Therefore, adoption of a routine also depends on how it fits into the routine complex. Government intervention influencing origination and/or adoption of a routine also influences these two stages for other routines indirectly.
8.6.4. MicroBA III: Retention of an Organisational Routine in a Firm by Public Intervention

As discussed in Chapter 6, Micro III in Dopfer and Potts’ framework is related to the normalisation of a routine. Once a routine clears Micro I and II, i.e. it is originated and adopted in the firm, it sometimes moves to a process where this routine normalises. This routine becomes an integral part of the routine complex and therefore diffuses to different parts of the firm. This is the process whereby this routine finishes its innovation journey within the firm.

I will now follow the same path I took in MicroBA II to explain the implications of this process. Firstly, one can talk about a government intervention, which carries a particular routine from Micro II to Micro III by rendering it as an integral part of the way of life in a firm. This is behavioural additionality. As this process takes considerably more time compared to MicroBA I and II, MicroBA III is highly likely to have a long-term impact.

Secondly, a routine that is originated and adopted because of government intervention can proceed to MicroBA III. Micro I, II and III together constitute the full learning cycle. This is the case of stronger and longer-term behavioural additionality whereas MicroBA I and MicroBA II represent weaker and relatively medium and short-term levels of behavioural additionality.

Innovation is the final issue in MicroBA III. The process of innovation involves creation of a novelty and its application (OECD and EUROSTAT, 2006). Therefore, in terms of microevolution of the firm, it spans the Micro I, II and III processes: a firm originates a routine, adopts it by applying it and finally normalises it to innovate. The implication for behavioural additionality is that if government intervention creates an innovation that would not have happened otherwise, by definition one can talk about behavioural additionality. Similarly, if intervention carries the result of an R&D effort to the application stage that could not have been applied otherwise and therefore would not have reached the innovation stage, then one can also identify this effect as behavioural additionality.

The number of cases where there is MicroBA I is likely to be higher than the number of cases for MicroBA II and III. In other words, normally one should expect government intervention to create more MicroBA I than MicroBA II and more MicroBA II than MicroBA III. This distribution would be the case because of two forces that work together. Firstly, microevolution includes an essential selection process through which the number of routines would decrease as the phases advance. Therefore, potentially there are a smaller number of routines that the government intervention could influence in later phases than in earlier phases. Secondly, considering the fact

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46 It is sufficient if the routine is novel to the firm, it does not have to be novel to the world to classify it as an innovation in this level.
that government tends to support firms with less established routines, a selection bias that involves a smaller number of late phase routines than earlier would be the case.

Exhibit 19: Phases of Micro Level Behavioural Additionality

<table>
<thead>
<tr>
<th>MicroBA I: Origination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creation</td>
</tr>
<tr>
<td>• Creation of new routines out of the blue with support</td>
</tr>
</tbody>
</table>

| Mutation               |
|• Change of existing routines with support |

| Recombination          |
|• Recombination of different routines |

| Migration and Diffusion |
|• Migration/Diffusion of routines to different parts of the firm |

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MicroBA II: Adoption

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MicroBA III: Retention / Normalisation
8.7. Meso Level Dynamics of Behavioural Additionality

8.7.1. MesoBA I: Origination of an Organisational Routine in a Population of Firms by Public Intervention

As I have discussed in Chapter 6, the meso level in the Dopfer and Potts framework (Dopfer et al. (2004) and Dopfer and Potts (2004, 2008, 2009)) represents the level of the population of a particular routine and its carrier, i.e. population of micro-evolutionary units. Here, I move away from the boundaries of a particular firm and go beyond a routine as practised by a particular firm.

Once a routine that is novel to its carrier population finishes its journey in a micro unit, i.e. it is originated, adopted, and normalised, it becomes available for other micro units. According to Dopfer and Potts (Dopfer et al. (2004) and Dopfer and Potts (2004, 2008, 2009)), this represents the very process of Schumpeterian (1934) creative destruction through which the micro unit gains a monopoly position and also disrupts the existing practice and corresponding establishment. This process, as a whole, is Meso I: origination of a new routine within a routine carrier population. Meso I is also the phase where the micro unit that normalised the routine in question enjoys monopoly position within its population.

Against this backdrop, I will now turn my attention to MesoBA I. When a government intervention carries a routine that is novel to the carrier population to MicroBA III: normalisation, the process of origination of this routine in the population constitutes MesoBA I. Population here could differ according to the purpose of the analysis: it could be beneficiaries of a particular intervention, firms in a particular sector, region, industry, or technological field. One can also consider populations of firms of particular size groups or technology intensities, etc. Therefore, if the government intervention carries a particular routine that is novel to a particular population (i.e. creates an innovation novel to that population) to MicroBA III and normalises it within a firm that belongs to the population in question, then the routine is originated to its population and therefore originated at the meso level. Any innovation that is created exclusively because of government intervention would be MesoBA I for the population that the firm belongs to and the analysis is focused. Therefore, for example, if a government intervention normalises a routine to implement the kaizen method in the aerospace sector for the first time (either by contributing to its origination and adoption as well or only influencing normalisation phase in a particular firm in the sector), then this routine is introduced to that population, and thus MesoBA I is created.
8.7.2. MesoBA II: Adoption of an Organisational Routine in a Population of Firms by Public Intervention

When a routine finishes its micro trajectory and its carrier originates itself to Meso I, it faces a harsh selection process. If the routine in question renders monopoly profits for its originator, other firms would be attracted to practise it as well. The first adoption of the routine brings chaos and radical uncertainty.

Consequently, this routine would be selected for adoption by the other firms within the population. Some firms would adopt this routine better than others as they have better 2nd order routines, the routine in question might fit their routine complex better, path dependant nature of routines makes a difference, etc. Others would not able to adopt the routine or would do it imperfectly. At the end, the phase marks a process of wide spread adoption of the routine leading to selective environment and path-dependence (i.e the competition process).

Three kinds of variety would be generated in this phase: i) routine variety where the routine forks out to different versions, ii) carrier variety where different types of firms practice this routine iii) and finally operational variety where the routine is used for different purposes.

Once again, it is important to discuss the implication for behavioural additionality. I have already discussed that if the routine that the government intervention carried from MicroBA III is novel to the carrier population, this represents Meso I. I can classify this issue as an innovation that is novel for the firm and its population in line with the Oslo Manual (OECD and EUROSTAT, 2006) definition. If this routine is not novel to its population, then the issue becomes adoption rather than origination. Therefore, if this routine is not novel to its population, then I can talk about adoption of this routine by yet another firm. This would be the case where the innovation would be novel to the firm but not to its population. Government intervention can play two roles in this phase. Directly, government intervention helps other firms adopt a routine that is already originated to its population through the processes explained in MicroBA. Therefore, it influences this routine to be selected in the population. Indirectly, government intervention contributes to the critical mass of the adoption of this routine so that it becomes attractive and more available for other firms to adopt. These two roles contribute to the variety generated in the process of adoption. Government intervention can directly influence routine, carrier, and operational varieties. Therefore, the dynamics of populations of routines, carriers, and operations are influenced by government intervention.

Size and velocity could also be influenced by government intervention. Some routines are bigger than others are and therefore they play a larger role in the economy. Dopfer and Potts argue that the distribution is power-law: there are only a few very large routines whereas their
numbers increase when routines get smaller. This implies that government intervention can influence the dynamics of this kind of population. Secondly, some routines are adopted faster than others are as they are more compatible with the dominant 2nd order routines within the carrier population. Government intervention can influence the rate that routines are adopted and therefore the dynamics of their population and their carrier population as well. Government intervention is a variety generation process in MesoBA II.

8.7.3. MesoBA III: Retention of an Organisational Routine in a Population of Firms by Public Intervention

The final phase of Meso evolution is the retention of a particular routine in a carrier population. Some of the organisational routines that make their way up from Meso I to Meso II reaches a state of wide adoption in the carrier population. This would reach to a point where a particular organisational routine is adopted by all of the firms that could potentially adopt it. Indeed, this particular routine becomes an institution or a social technology as Nelson (2009a, 2009b; Nelson and Sampat, 2001) calls it.

Government intervention can facilitate a routine to proceed to Meso III and to become a social technology (or institution) by endowing it in the selection process it faces in Meso II. This constitutes MesoBA III. As in the case of microevolution, government intervention is less likely to create MesoBA III than MesoBA II and I. In other words, one should expect a higher number of routines gone through MesoBA I than MesoBA II and the numbers for MesoBA III tend to be even lower.

MesoBA III is essentially a variety-decreasing process. The number and types of routines that are adopted increase in the MesoBA II phase. However, in MesoBA III, one of the different varieties of a routine becomes dominant in its carrier population. Furthermore, it gains an advantage against alternative routines until another routine starts from Micro I and gradually reaches to a level to disrupt it.

8.8. Macro Level Dynamics of Behavioural Additionality

8.8.1. MacroBA I: De-coordination

The unit of analysis in macroevolution is now beyond a particular routine. Nelson (2009a, 2009b; Nelson and Sampat, 2001) draws attention to the importance of institutions in the sense of widely practised routines. He calls it ‘social technology’ in comparison with the ‘physical technologies’ and concludes that in the absence of social technologies, physical technologies are
not sufficient for progress. The unit of analysis of macroevolution is, therefore, routines that progress to a normalisation phase (Meso III) in the whole routine carrier population.

When a routine finishes Meso III and reaches Macro I, it reaches a level where it influences the economy and the constituent routines that form the economy. In this phase, this social technology disrupts the macro order which is otherwise in coordination. An example for this kind of a process would be Fordist production. It first started as a routine, a way of producing cars in the Ford Company; it then cleared the process of Micro I, II and III within Ford. Afterwards, it became available to, for instance, the car manufacturing industry. Other firms started to practise it, albeit slightly differently which brought variation. Finally, the big routine of Fordist production became a social technology or institution that threatened the established order of the macroeconomy at some point. The role of the government intervention in this phase would be to reinforce a social technology that would not have cleared Meso III so that it reaches Macro I and de-coordinates the system.

8.8.2. MacroBA II: Re-coordination

In this phase, the social technology that brought de-coordination to the macroeconomic order settles and becomes part of the order. Dopfer and Potts (Dopfer et al. (2004) and Dopfer and Potts (2004, 2008, 2009)) discuss three kinds of situations where the structure formed by all routine populations that fit together with themselves and their carriers fail to coordinate. Firstly, there can be an operant coordination failure in which ostensive aspects of routines fit together but not their performative aspects due to business cycle capacity maladjustments. Secondly, there is the case of surface coordination failure in which routines are under-adopted or over-adopted. Finally, there is the deep coordination failure in which routines do not fit together.

I will now analyse all three failures from the angle of behavioural additionality. Regarding the operant coordination failure, government intervention can bring strategic intelligence to the macro order so that the actors are more ready and aware of the wider environment. This would bring elimination of some lags in situations where actors bear ostensive aspects but fail to coordinate to form the performative aspect of social technologies. An extreme example to this kind of situation is the macroeconomic re-coordination of the Russian economy after the collapse of the USSR. A set of huge 0th order routines regarding to mode of operation of the economy (collective planning) collapsed and led to massive de-coordination in Macro I. Consequently, what was left from the government failed to steer the coordination of the otherwise superior aspects of some established social technologies in various areas. One particular area that was affected was space exploration and allied domains in which there were established social technologies with intact and efficient artefacts but they did not fit into the
performative dimensions at that time because of an external shock. Secondly, the case of surface coordination failures can be exemplified with the lock-in to inferior fossil-fuelled combustion engine technologies constellation. This huge constellation of social and physical technologies was inferior to for example electric-powered motors as discussed by Arthur (1990). However, the surface coordination failure that could be foreseen by strategic intelligence methods (e.g. technology foresight) and addressed by government programmes at the micro and meso levels, could have been avoided. This would essentially be an example of MacroBA I and II. Finally, one can think of the case of the dot-com boom as an example of deep coordination failure. The constellation of physical IT technologies that was recently made available at the beginning of 1990s were insufficient to proceed from Macro I to Macro II as the social technologies available at that moment in history were not fit into (Freeman, 2001; Oliner and Sichel, 2000). Again, the ineffectiveness of the government that could have encouraged the creation of 2nd order routines that could create social technologies in key sectors like banking contributed to this story. Had there been a government intervention to address this failure, it would have been an example of MacroBA II. All these three failures have long been discussed and branded with many names (most of often as systems failures) (Bach and Matt, 2002, 2005; Bryant, 2001; Dodgson et al., 2010; Smith, 2000). Almost all of the descriptions point in the direction of a government intervention strategy that starts from MicroBA and MesoBA. This phase has also been the subject of the technological paradigms / regimes literature (Dosi, 1982; Georghiou et al., 1986).

8.8.3. MacroBA III: New Order

As discussed in detail by Metcalfe (1995a), Macro III is the phase where all the social technologies are absorbed and normalised by all the meso units. This is also the phase where economic evolution is complete until it is disrupted by a new de-coordination. From the angle of behavioural additionality, this is the phase where the efforts by government intervention addressing operant, surface, and deep coordination failures successfully pays off. However, just as the fact that Macro III is a very rare and historic phase, MacroBA III is highly difficult to attain and offers the ultimate reward for those who can. The whole process of behavioural additionality is summarised in Exhibit 20.

8.9.1. Possibility of Behavioural Additionality

I will now my attention to the relevance of the above discussed conception of behavioural additionality to policy-making because as Nelson and Winter (1982: 372) argue “the ability of a theory to illuminate policy issues ought to be a principal criterion by which to judge its merit”.

A set of questions still need to be answered. I will start with a discussion of a fundamental question: given the complex nature of evolution of organisational routines in the various intertwined layers, phases and orders, is it possible to implement an innovation policy aiming behavioural additionality at all for any good?

The famous Hayekian (1945) theorem of impossibility posits that because knowledge is tacit and distributed across different agents often imperfectly, it is impossible to grasp the true dynamics of the evolutionary nature of the economy. That is exactly why government cannot and should not plan and therefore disturb the evolutionary economic system that is impossible to influence for good. Government must only set the framework conditions (0th order routines) through which the system can work and evolve. There is simply no possibility that the government can fix a market failure without creating a bigger government failure. Hayekian theorem of impossibility is often used as an argument against any kind of government intervention even in the form of the...
neoclassical rationale for innovation policy which is quite simple and reserved in terms of the role that it conceives for intervention.

Within this backdrop, one can even think that the conditions are even more serious than Hayek (1945) conceptualised because of five evolutionary forces that makes the case for intervention weaker. Firstly, the evolutionary dynamics discussed above represent a picture that is more complex in terms of the agents' behaviour than neoclassical theory understands. Secondly, I have discussed a path dependant process of evolution of routines of agents. The case for systems failure and failures that limits cognitive capacities of agents as discussed in Chapter 4 contributed to this. Furthermore, not only is this valid for the routines of the firms that are supported but also the government intervention is governed by routines that are limited by the same conditions. Therefore, we now face a system where agents behaviour evolve in a path dependant fashion and also the shape of the government action that tries to influence it is bound by the same force. Thirdly and similarly, both the government intervention and the agents' behaviour are irreversible (Wegner and Pelikan, 2003). It is not possible to undo something that is already done: 'no policymaker is for turning' even when they want to do so. Fourthly, the government intervention, in this backdrop, is only one of the multiple attractors that the economy follows in its evolution. Fifthly, contrary to its neoclassical counterpart, the evolutionary policy-maker faces a fundamental / pervasive uncertainty that obstructs all possible alternatives (whereas in neoclassical universe, the alternatives are known and probabilities can be assigned). Therefore, the knowledge problem that Hayek raised is so great that it is almost impossible for the state to increase social welfare (Moreau, 2004).

However, this is only one side of the coin. On the other side, unlike neoclassical counterparts, evolutionary policy-makers do not need to comprehend every possible state of the economy. I have extensively discussed in Chapter 4 that, the aim of the evolutionary policymaking is not to optimise the system to reinstate the best condition distorted by some external shock. As it is repeatedly claimed, discussed and exemplified by many scholars, the role of the government in evolutionary thinking is not to address adverse end states but to experience the process itself.

8.9.2. Importance of Behavioural Additionality

Another question that is of central importance to my cause here to extend this point and therefore addresses Hayek's theorem of impossibility is: Why and how should the government create behavioural additionality at all?

Metcalfe argues that (2003: 179)

"the dynamic features of modern capitalist economies depend crucially upon their capacities as experimental systems; systems which continually generate varieties of behaviour to be tested,
adopted or rejected in the economic and social spheres. Innovation qua variety generation combined with the properties of selective processes makes competition an adaptive, evolutionary process.”

Within the backdrop I have discussed above and also in Chapter 4 and 6, Metcalfe outlines that there could be three roles for government in innovation policy (Metcalfe, 1995a, 1995b, 1998, 2003, 2005; Metcalfe and Georghiou, 1998; Metcalfe and Ramlogan, 2008):

A. Facilitating the Market Process:
First, government should facilitate the market process, as the market itself is an efficient selection environment for an evolving economy. Through market process and the competition it generates, firms get their rewards for the innovations they created by origination, adoption and retention of their routines. Through market processes, these routines are selected in routine carrier populations through origination, adoption, and retention. Finally, market process facilitates the macro order. The market is a huge set of 0th order routines and government should ensure that these routines are working correctly. This is essentially an area where competition and innovation policy intertwine. Furthermore, government intervention might create behavioural additionality by helping firms to align their 1st and 2nd order routines to the given 0th order routine of market both nationally and internationally. If firms have better 1st order routines to adapt the running markets or better 2nd order routines that enable them to adjust the changing conditions of the market, they perform better.

B. Boosting Variety:
The second role for government is boosting variety. The fuel of the competition is variety, but market as a selection process decreases variety. Therefore, variety should be sustained so that the economy can regenerate. The purpose of the policy is not to increase the social welfare but to enhance the learning process of the firm to generate variety in behaviour. The role of the government is to contribute to this process of increasing variety. This is a point where almost all evolutionary scholars agree and focus on. Metcalfe (1995a: 1561) brands this as “the central dynamic question we must address if change is to be explained”.

How is variety generation related to behavioural additionality? One of behavioural additionality’s two most important functions is generating variety (the second one is facilitating selection that I will discuss shortly). Behavioural additionality generates variety at three different levels. At the first level, behavioural additionality generates variety within the firm. Without repeating the discussion of Chapter 5 and the above sections of this chapter, the firm operates through routines and innovation involves changing these routines through other higher-level 2nd order routines. The MicroBA I phase originates routines that would not have been originated within the
firm and thus generates variety in the collection of the routines of the firm. The MicroBA III phase normalises this innovation within the firm in a way it would not have been the case without the intervention and therefore introduces this routine and innovation to the population. Consequently, MesoBA I originates routines to populations and therefore disseminates this variety to other firms and therefore creates variety at the population level. Furthermore, in Section 8.6.2, I have already discussed that in the phase of MesoBA I, government intervention creates routine, carrier, and operational variety. MesoBA III normalises this routine and makes it a social technology. This leads to the MacroBA I phase where government intervention might help some widely exercised routines (i.e. social technologies or institutions) to the macro order and hence create yet another level of variety here. Through all these processes government intervention allows for experimentation and boost diversity (Schwerin and Werker, 2006). A rich knowledge ecology in which agents generate innovations by interacting with each other, reinforcing the experimental evolutionary process, producing new knowledge, and therefore creating variety is the ultimate aim (Metcalf and Ramlogan, 2008) and this could only be attained by behavioural additionality. If a government intervention does not create variety, in other words, if MicroBA I, MesoBA I and MacroBA I processes are absent, then this intervention is a failure from the angle of the evolutionary approach.

C. Guiding Selection:
The third role of the government from the evolutionary angle according to Metcalfe (1995a, 1995b, 1998, 2003, 2005; Metcalfe and Georghiou, 1998; Metcalfe and Ramlogan, 2008) is to guide the market by learning about different punctual attractors and ensuring that the system does not lock-in to a socially inferior one. In other words, the government should ensure that there is no adverse selection that detrimentally changes the relative importance of organisational routines and therefore innovation. This would allow agents “to incorporate growing knowledge and adapt to changing circumstances” (Hodgson, 1999: 248).

Once again, how is guiding selection related to behavioural additionality? I have already discussed in Section 8.6.3 that the government intervention helps a firm to adopt a routine that it could not have selected otherwise. In MesoBA II, government intervention facilitates the selection of a routine at the population level. Finally, the MacroBA II process is essentially a re-coordination process in which a social technology settles. In all these phases, behavioural additionality facilitates the selection processes in a way it could have happened had there been no intervention. Government should guide the negative and positive feedback loops in these processes.

Having addressed the question as to why government should create behavioural additionality, I will now return to the issue of how to accomplish this remit. First, government should be
adaptive in all these three aims faced amid changing circumstances. It is almost impossible for government not to make any mistakes and create government failures, but this does not mean that Hayek’s impossibility argument should be accepted and government should refrain from intervening. On the contrary, government should recognise that there would be failures all along and therefore it should be flexible to be able to adapt to changing conditions. Behavioural additionality is the ideal instrument for this task: through the process of learning that behavioural additionality evaluations create, government can understand the dynamics of evolution and learn from the process. Secondly, government intervention is governed by routines as well and evaluation of behavioural additionality is the ideal tool to improve the performance of this routine. In short, behavioural additionality is the main process of an adaptive policy-making that tries to generate variety and experimentalism rather than to optimise the economy by recognising the fact that the deviant behaviours originate economic change (Metcalfe, 2003). Therefore, the adaptive efficiency of the government decides the success of behavioural additionality.

In a similar vein, Moreau (2004) argues that evolutionary innovation policy should favour incrementalism. As I have discussed above, the pervasive uncertainty that the evolutionary dynamics of the economy posits necessitates this kind of incrementalism rather than radicalism to minimise the risk of government failure. As Nelson and Winter (1982) beautifully put it, evolutionary innovation policy is rather like a chess game in which the final outcome is different than the outcome of each move and the strategies are different. Incremental change teaches policy-makers about several steps and therefore offers them a chance for a more appropriate course of action in the next step. Big steps require an inconsistent and unrealistic amount of foresight, which is beyond any policy-maker’s power. Small steps, however, can be more attainable. Incremental steps give a chance to reverse previous errors before they distort the system. This understanding necessitates an innovation policy in line with the behavioural additionality framework discussed above. Change can only be created adaptively and incrementally. Innovation creation in the firm level should start from origination of routines with various sub-processes (MicroBA Ia, Ib and Ic), it should be followed by adoption (MicroBA II) and normalisation (MicroBA III) at the firm level. Consequently, only this kind of an incremental movement would allow introduction of change at a population level (MesoBA I, II and III). Finally, macro level change (MacroBA I, II and III) should generally start from micro or meso behavioural additionality.

The second strategy that the policymaking should embrace is to reinforce the above-discussed three main issues (i.e. facilitating the market process, creating variety and guiding selection) by devising concrete ways to connect agents to each other. Unlike neoclassical theory, free flow of
information (or in some cases the existence of information) is not taken as granted by evolutionary logic. Therefore, it is sometimes government’s duty to ensure that there are patterns of connection between different agents within the ecology. Government must “create and oversight” [sic] a set of rules of the game that openly facilitate the formation and co-ordination” for those areas where the government does not fully grasp (Metcalfe and Ramlogan, 2008: 442).

According to Moreau (2004), if the government improves coordination between agents and the state and among agents, it also improves the market process that is an efficient, decentralised and distributed information sharing mechanism. This would solve problems of critical mass and coordination. Similarly, imposing conditions generally does not work. According to Gerybadze (1992), a policy can only be successful if strategies of both government and firms are compatible. In an environment where there are information gaps, forcing firms simply fails. Government should try to influence routines and persuade firms to adopt particular behaviour. In other words, adaptive policy-maker tries to influence and guide rather than force. In Metcalfe and Ramlogan’s (2008) words, the issue is not only about forming an innovation system as a static structure, but the government should “influence the innovation ecology and the propensity to make connections”. Again, this point reinforces the importance of the behavioural additionality process in which change is incremental, dynamic, diffusive, and enacted through persuasion. As discussed earlier in this chapter, collaboration has already been a core issue in the behavioural additionality literature and practice but its importance has never been convincingly explained. This argument brings the essential *raison d’etre* to collaboration.

### 8.9.3. Input and Output versus Behavioural Additionality

I will now revisit the first question I posed: how to reconcile with the Hayekian argument that innovation policy is an impossible endeavour? Until now, I have discussed that there is a case for an innovation policy where government intervention creates variety, facilitates market process and guides selection by influencing organisational routines at the micro, meso and macro levels in an incremental and adaptive manner. Similarly, I have criticised the practice and literature of evaluation that legitimises the measurement of input and output additionality alone. However, these still do not invalidate the Hayekian argument.

Inspired by Wegner’s (1997) framework, I will discuss a very common situation where a policy is evaluated for its input, output and behavioural additionality as summarised in Exhibit 21. As is discussed in Chapter 3, most evaluations of additionality cover all three types of additionality. Most of these policies have input and output additionality as their performance indicators for these two concepts are easily defendable and understandable. Similarly, a significant number of
these policy measures try to use behavioural additionality as a new argument to prove their success when they fail in input and output additionality (Gok and Edler, 2010).

**Exhibit 21: Input and Output Additionality versus Behavioural Additionality**

<table>
<thead>
<tr>
<th>Case</th>
<th>Opportunities</th>
<th>Political Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Hidden Failure</td>
<td>Constant</td>
<td>Achieved</td>
</tr>
<tr>
<td>II. Harmful Failure</td>
<td>Constant</td>
<td>Not Achieved</td>
</tr>
<tr>
<td>III. Long-term Success</td>
<td>Extended</td>
<td>Achieved</td>
</tr>
<tr>
<td>IV. Hidden Success</td>
<td>Extended</td>
<td>Not Achieved</td>
</tr>
</tbody>
</table>

In this common case, I will go through four different situations categorised according to the opportunities (or variety/exploration/experimentation) they create (i.e. behavioural additionality) and the short-term political performance they yield (e.g. input additionality). Case II where the policy does not create any opportunities (i.e. no behavioural additionality) and does not fulfil the political targets (e.g. no input and output additionality) is a monumental example of Hayek’s case as a harmful failure. This is where the policy does not lead to an evolution and fails to meet shortsighted political goals. Case I is the situation where the policy creates some input additionality but does not create any behavioural additionality as it does not expand the opportunity set. This is where the hidden failure that undermines most of the policies lies. In Wegner’s (1997) words, it is a case of achievement by chance.

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47 This framework is inspired from Wegner’s (1997) framework but radically adjusted and used in substantially different meaning.

48 As I hinted previous sections and chapters, adjusting R&D spending is also governed by routines and therefore increasing a firm’s R&D spending in a persistent manner by influencing its corresponding routine could be behavioural additionality. Therefore, input additionality and behavioural additionality are not mutually exclusive concepts, nor they are alternatives to each other. Input additionality is a very specific and narrow case of behavioural additionality just as equilibrium is a very specific and rare case of the phase Macro III. However, I used input additionality as an example of a simplistic political goal here as it is widely understood.
I turn my attention to another dominant case (case IV) where there is behavioural additionality but because it cannot show simplistic success in terms of input additionality, it is only a hidden success. Finally, the best case (case III) is the long-term success where the opportunity set is expanded (i.e. behavioural additionality created) and easily defendable but a rather misleading indicator of input additionality is created as well.

This example shows us two things. First, as Wegner (1997) points out the general scepticism of neoclassical theory for public intervention and the Hayekian impossibility theorem should be replaced by a theorem of riskiness. There is a risk for failure but also an opportunity for success. Second, because of short-sighted policy-making which only relies on simplistic and misleading indicators such as input additionality, the position where a policy only creates behavioural additionality might be a more unstable position compared to one of a more ‘long-term success’ where both behavioural additionality and input additionality are present.

8.9.4. Evaluation of Behavioural Additionality

I will now deal with a final issue: what does this new understanding of behavioural additionality imply about its evaluation? As it has already been established earlier in Section 8.4, the analysis is generic as well as the implications. However, it is still possible to discuss some overarching fundamental issues related to the evaluation of behavioural additionality.

Inspired by Goodman (1983) and other scholars of philosophy of science, Cowan and Foray (2002) argue that logically, counter-factual conditionals, scientific laws, dispositional statements, factual conditions, statements regarding possible worlds, and finally causal statements can be rephrased in another and thus they are equivalent within the confines of the neoclassical theory. This means that the following axioms can be evaluated by using practically the same criteria / test / method:

- Counter factual conditionals: had there been no government intervention, the firm would have behaved differently.
- Scientific laws: a £1 change in government spending changes firm behaviour by X%.
- Dispositional statements: government intervention has a tendency to change firm behaviour (by X% per pound).
- Factual conditions: since firm behaviour changed by X%, government must have invested £Y.

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49 Although theoretical economics is much closer to the idea of multiple equilibria (as a lean towards a more evolutionary understanding), empirical economics is still stuck in the comparative statics.
• Statements regarding possible worlds: in a world like ours but with £Y government intervention, we would observe X% change in firm behaviour.

• Causal statements: Changes in firm behaviour are caused by (inter alia) changes in government intervention OR because of government intervention, firm changes its behaviour.

I have already discussed in Chapter 2 that the experimental and quasi-experimental causation of the mainstream evaluation theory logically leads us to more or less the same conclusion with additionality. I will now attempt to shed more light to the relationship between causation and counterfactual conditionals.

Cowan and his colleagues (Cowan and Foray, 2002; Cowan and Rizzo, 1996: 278) point out two possible types of causation. Sustaining causes are “unidirectional determinants that maintain an equilibrium state of affairs”. They are the focus of neoclassical theory, as they focus on the end states (i.e. equilibrium) not means. Therefore, the sustaining causation tries to explain issues in terms of how they affect the equilibrium. An example for this would be the following:

To close the R&D investment gap, the government A started a programme. Now for every £Y government investment in R&D, the private sector spends £(Y+ε). Therefore, government intervention created £ε of input additionality and hence it closed the investment gap and (helped to) maintain the second-best.

However, in the absence of a unique equilibrium (e.g. if there are multiple equilibria), one can talk about a second type: originating causation. Here, the concern is to understand the causes (i.e. the means or the process) of becoming. According to Cowan and his colleagues, originating causation requires an evolutionary and hence historical analysis while sustaining causation is not path dependant and history friendly. This is also true for corresponding counterfactual statements. An example for this kind of causation would be the following:

To be able to increase competitiveness, government B decided that it needs to increase variety, facilitate the market process and guide the selection within the economy. To this aim, it implemented a programme. The accumulative and path dependent process of origination, adoption and retention of organisational routines of the supported firms created behavioural additionality.

I will now return to the issue of counterfactual statements and attempt to identify a corresponding classification. One could read counterfactual statements in two possible ways. First, counterfactual statements can be about possible worlds. In a possible parallel world where everything is exactly the same as our world except for the particular government intervention, which changes the behaviour of a particular firm. Therefore, the government intervention created
behavioural additionality. This view holds a strict *ceteris paribus* view; everything is constant but one parameter. This view corresponds to the sustaining causation. The analysis of behavioural additionality in this view can be done by comparative static; the two stationary worlds are compared and the difference is attributed to behavioural additionality. One only needs to establish the situation in both worlds by using some experimental or quasi-experimental technique and subtract them from each other.

The second and evolutionary way of reading counterfactual statements is what Cowan and Foray (2002) call a branching view. This view acknowledges that history is like a tree where each decision represents a separate branch. Therefore, counterfactual analysis is returning to a point where another branch is chosen. This implies that there is complexity and therefore one needs to understand all possible branches after the point of comparison to be able to compare counterfactual to the actual. To be able to truly understand what would have happened had there been no public intervention, one needs to trace every critical branching point after the public intervention up until now (and maybe even considering possible future consequences). Therefore, comparative statics is not enough to explain behavioural additionality; one needs to unfold the dynamics.

The branching view on counterfactual statements makes the new understanding proposed more important. As I have discussed above, Hayekian impossibility theorem implies that we cannot know and calculate every possible branch. However, we can have an idea about patterns and overarching issues. Therefore, to be able to grasp the dynamics of the behavioural additionality in a particular time and space, one needs to understand the context conditions and also have a sound theory as to how government intervention contributes to the evolution of organisational routines. This involves, of course, the use of what is called a logic chart approach where the objectives, aims and modalities of the programme are considered while evaluating impacts. However, what I mean here is a wider and more fundamental understanding than simple intervention logic. The theory I developed in this chapter is a generic understanding as to the basic evolution of the organisational routines by the government intervention that is compatible with a spectrum of logical frameworks.

The experimental and quasi-experimental methods that help us establish a parallel universe (by either a random experiment or a second best proxy of before-after groups or control groups as discussed in Chapter 2, etc.) where everything but the intervention is the same are not enough by themselves to grasp the dynamics of behavioural additionality (even though the problems of establishing these two worlds are eliminated as discussed in Chapter 2). However, they are not completely uninforming either: these evaluation designs can be used in principle as part of a more complex evaluation endeavour as long as the analysis takes into consideration evolutionary
branching process and attempts to employ these evaluation designs to unfold each critical branching. Similarly, non-experimental designs such as case studies are critically essential to reveal the dynamics. Experimental and quasi-experimental methods must always be buttressed by non-experimental methods (Georghiou, 2007).

This framework has a number of further implications on the evaluation of behavioural additionality. For these still uncovered issues, I will follow the lines of the current evaluation characteristics of behavioural additionality as established in the quantitative analysis presented in Chapter 3. I have concluded there that behavioural additionality evaluations are evaluated in less ex-ante and interim, same accompanying and more ex-post timings than other kinds of evaluations. Similarly, three quarters of behavioural additionality evaluations are evaluated in stationary timings as interim and ex-post evaluations are evaluated one point in time. The history friendly and path dependant nature of behavioural additionality, however, necessitates that behavioural additionality should be evaluated along the entire funding cycle and beyond.

Another issue is related to the purpose of evaluations. I have established that one-fifth of behavioural additionality evaluations are only summative (i.e. they have no formative element at all). This is because behavioural additionality is more linked with the legitimisation utility while it is only loosely related with the policy learning utility of evaluations. Within the framework explained above, an exclusively summative analysis (that does not provide any policy learning) cannot be history-friendly and path-dependant. Similarly, it cannot contribute to adaptive, incremental, dynamic, diffusive, persuasive policy-making. Any behavioural additionality evaluation must have at least a formative element in it.

I have showed in Chapter 3 that three-quarters of behavioural additionality evaluations use monitoring data and / or existing surveys and databases (similar to other evaluations). However, it is now clear that these information sources are among the most important ones. The historical and path-dependant nature of behavioural additionality might not be covered by only ex-post data collection practices. A sound monitoring system that is founded on a theory of behavioural additionality and corresponding logic model of the programme would be the most effective tool to capture most of the dynamics as also pointed out by Edler and Guy (2010).

One final issue is about the use of new methods in evaluating behavioural additionality. Chapter 3 shows that only one-fifth of behavioural additionality evaluations employed a network analysis. This was concluded as interesting as most of the behavioural additionality evaluations deal with the issue of collaboration as the foremost example of behavioural change. Similarly, there was no significant use of simulations at all. It is now clear that meso-level population dynamics cannot be grasped without using these techniques, at least in some cases. Furthermore, simulation seems to be the most viable technique to understand macro level behavioural additionality.
8.10. Conclusion

As the core of this thesis, I have first discussed the underlying implicit assumptions of the current understanding of behavioural additionality, which revealed a fundamental contradiction with the main features of evolutionary thinking. Consequently, I have argued for a new understanding of a truly evolutionary behavioural additionality consisting of micro, meso and macro levels. Behavioural additionality at those three levels that influence the evolution of a firm’s routines, consequently generating change in the population of routines and ultimately affecting the macroeconomic order is the main framework of the new understanding of behavioural additionality. Behavioural additionality is an adaptive incremental process, which ultimately facilitates the market process, boosts variety, and facilitates selection at the micro, meso and macro levels.
Part II

Chapter 9: An Empirical Application of the New Understanding of Behavioural Additionality
9.1. Introduction

This chapter constitutes the empirical application of the micro level of the new understanding developed of behavioural additionality developed in Chapter 8. As discussed in Chapter 7, this chapter applies a plausibility probe case study method, which also includes illustrative case studies. The main aim of this empirical part is not to conduct a full-scale test of the approach developed in Chapter 8 for various reasons outlined in Chapter 7. Nor will I attempt to use these case studies deductively to feed into the findings of Chapter 8. Rather, this chapter’s aims are

- **As an illustrative case study:**
  - to provide examples (of micro level behavioural additionality as argued in Chapter 8) and by doing so “to give the reader a ‘feel’ for a theoretical argument by providing a concrete example of its application” (Levy, 2008: 6).

- **As a plausibility probe:**
  - to build a preliminary and limited empirical model (to evaluate the micro level of behavioural additionality as understood in this thesis) to be able to provide evidence that the approach of this thesis can be applied to real life cases.
  - to discuss a number of cases in a limited fashion to conduct a preliminary sensitivity analysis for the theory developed for behavioural additionality to be able to derive lessons for the applicability and evaluation.

The outline of the chapter is as follows: Section 9.2 of this chapter outlines the approach, Section 9.3 presents the case studies, Section 9.4 synthesises them and finally Section 9.5 concludes.

9.2. The Approach

The approach used in this chapter involves two stages. In the first stage, the selection of the cases as well as analytical issues such as the unit of analysis are considered. As these case studies aim to illustrate the theory developed in Chapter 8 and also to provide a test to prove whether it is possible to operationalise the theory, the unit of analysis is organisational routine. However, as I discussed in Chapter 5, organisational routines are highly context sensitive and path dependant. Therefore, it is not possible to discuss them without putting them into perspective first. To this aim, the case studies first characterise the funding programmes. Subsequently, each firm is described in terms of their basic characteristics. Finally, the projects through which firms were supported are described before discussing routines evolved due to government intervention. Therefore, as part of the case study, two different programmes are selected and a
number of firms in each programme are studied. Within each firm, the case study focuses on one or more projects supported by the programme to analyse their organisational routines.

As discussed in Chapter 7, the cases are selected to represent a wide variety of firms and projects to be able to increase the rigorousness of the plausibility probe. The case study for the Turkish TIDEB programme in which six firms were interviewed was conducted first. Following this, the second case on the British Collaborative R&D programme required a fewer number of firms to be analysed as the first case has already provided a reasonable base. Therefore, the second case only looked at those phases and process of micro behavioural additionality that the first case left unanswered.

The second stage is conducting the study, which involves three steps. First, a discussion on the performance of the firm, new capabilities developed and activities performed are entertained to be able to narrow down to routines. A second step before focusing on routines is discussing the additionality of the project by analysing the way the projects are performed is influenced by the intervention. Finally, routines and the behavioural additionality created through them are investigated by analysing their aspects/dimensions as well as their consequences. These steps are discussed in this section and also summarised in Exhibit 22.

Although the unit of analysis is particular routines within particular firms and in the context of particular projects, for two firms this sequence cannot be sustained. For these two firms, it was not possible to talk about particular projects for a number of reasons. Rather a set of projects supported by the respective programmes are used for these two firms

9.2.1. Scoping

In this part of the interviews, scoping questions are asked. There are two aims in this part. Firstly, the experience of the firm cannot be narrowed down to routines immediately. As I have discussed in Chapter 5 routines are not very easy to talk about directly (Becker, 2005b). Therefore, as per the lesson learnt from the pilot interview as discussed in Chapter 7, one needs to start discussion from broader issues such as (i) the performance that the firm accomplished with the project, (ii) the capabilities they have developed to accomplish that performance (iii) and finally activities to achieve that performance and to develop these capabilities. The second reason is native to the case study research. As Pentland and Feldman (2005, 2008) clearly point out, the ostensive aspect of routines poses a high degree of subjectivity in particular. Therefore, one needs to develop an etic view of the routines. This can only be done by aligning the vocabulary of the researcher and different people within the firm to each other. This in turn requires a discussion of some broader issues for which developing an etic view is easier.
As also presented in greater detail in the interview guide presented as Annex 2, the basic questions are as following:

- **Performance**: What have you achieved with that project? Have you realised any concrete benefits?
- **Capabilities**: How have you achieved these performances? What kind of capabilities have you developed? What are the causes of this performance?
- **Activities**: What kind of activities have you performed to be able to realise these performances? What kind of activities do you do (that this project attempts to tackle)?

### 9.2.2. Changes During the Project

This part is about the additionality of the activities the firm performed in relation to the project under the microscope. The difference between what kind of activities they would have done in this project had there been no support from the government and the actual activities are investigated. Furthermore, probing questions such as what kind of activities they would have done if the support were half of what they received are asked to streamline the discussion.

### 9.2.3. Narrowing Down to Behavioural Additionality

Up until now, the focus was on the project. This part now deals with the issues with which the project attempted to tackle. I have extensively discussed in Chapter 5 that from the angle of the performance feedback theory, firms initiate a search process (the project) that is either problemistic (that is aimed to solve a concrete problem), slack (that utilises a slack resource) or institutionalised (that is done by purpose functioning units). At the end of this search process, learning occurs and it involves a change of routines. This part of the discussion is concerned with identification of these changes in routines due to the project and attribution of these to the support.

#### 9.2.3.1. Identification of Routines

To identify routines developed because of the project or influenced from it, it is important to understand how their routines have been originated, adopted, and normalised because of the government intervention. The discussion starts with the identification of routines in their simplest form. Here, it should be noted that although identification of these routines seems to be quite easy, it is imperative that this is done properly to be able to proceed to the attribution later on.

- **The umbrella question in identifying the routines involved**: What kind of tasks do you do to accomplish these activities? What has changed in the way you do these activities?
9.2.3.2. In-Depth Discussion of Routines

After deriving a list of routines, of which there are a few, I discuss each of these routines in greater detail. This section utilised a strategy inspired from Becker (2005b). He suggests that one can analyse routines by tracing their antecedents, characteristics, and performance outcomes. In line with his strategy, sources/aspects of routines and consequences of routines are discussed.

9.2.3.2.1. Sources/Aspects of Routines

I have discussed in Chapter 5 and utilised in Chapter 8 that routines have three dimensions/aspects (i.e. ostensive, performative and artefact). These dimensions must be in place to be able to identify an interaction pattern as a routine. Government support creates behavioural additionality by creating and/or reinforcing one or more of these aspects. Therefore, the discussion focused on these issues. For each of the routines identified, questions exploring the ostensive, performative and artefact dimensions of routines are asked and for each dimension, the role of the government intervention is analysed.

9.2.3.2.2. Consequences of Routines

As discussed in Chapter 5, routines have some consequences. These consequences are grouped into the following categories and discussed in interviews in order to identify behavioural additionality:

- Coordination and Control / Truce
- Learning / Stability
- Economising Cognitive Resources / Reducing Uncertainty
Exhibit 22: Case Study Approach

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9.3. Case Study A: Turkish TUBITAK-TIDEB Programme

9.3.1. Characteristics of the Programme

Target Audience: The targeted firms are all the firms engaging in industrial and software development activities.

Definition of R&D and Innovation: The framework of R&D projects was in line with the definition of experimental development in Frascati terminology. Similarly, the framework for the innovation was defined in accordance with the Oslo Manual (OECD and EUROSTAT, 2006). Therefore, it covered only product and process innovations and excluded newly-defined marketing and organisational innovations. Activities that can be supported are:

- Conceptual development
- Technological / technical and economical feasibility studies
- Laboratory studies to be conducted in the process of transition from conceptual development to design
- Design and drawing studies
- Prototype production
- Establishment of pilot plant
- Trial production
- Patent and licence studies
- After-sales support

Support Basis: The support for R&D is on a grant basis. The maximum amount that could be supported by the public funds was 50% of the project budget. Support ratio could be increased in the following cases:

- 10% increase in support could be applied for the projects that have patent outputs. It means that the total support ratio was 55% at maximum for such projects.
- Up to 20% increase in support could be applied for the firms that generate more than half of its revenue from previous R&D studies. The total support ratio was 60% at maximum for such projects.
- 20% increase in support could be applied for the projects that were conducted in the following priority areas:
  - Informatics
  - Flexible production
  - Advanced material technologies
  - Biotechnology / genetic engineering
Support Duration: Projects up to a span of 3 years could be supported.

Expenditures Supported:

- Personnel Expenditures: However, it is worth noting that although the Frascati Manual (OECD, 2002) enumerates the categories of R&D Personnel as researchers, technicians and equivalent staff and other supporting staff, the decree indicates that only the costs incurred by researchers and technicians and equivalent staff would be considered as R&D personnel expenditure.
- Expenditures for instruments, equipment, computer software that would be used for R&D purposes.
- Expenditures for consultancy services and other services that would be used for R&D purposes.
- Expenditures for extramural R&D that was conducted by universities, public research organisations (TUBITAK institutes) and other private undertakings could be supported.
- Patent application expenditures.
- Direct expenditures for materials etc. to be used at R&D activities.

Modalities of the Programme: It is a bottom-up programme. Firms themselves decide on the subject of the project and there is no time limitation or other restriction for the application to the programme. It is an open call programme. Project applications can be submitted anytime as long as the expenses covering at most the preceding 3 months can be supported.

It is a distinctive characteristic of the programme that the payments are made on a term basis. In other words, the firm spends the money for R&D in advance and sends a technical and financial report for their activities every 6 months (i.e. every term, a year is considered as two terms), and only after this report is approved, the money the firm spent can be reimbursed. This term system leads to many complaints that it is not an R&D support but a reimbursement programme.

Neo-classical argument postulates that the technology policy and apparatus of technology policy like TUBITAK-TIDEB50 programme exist because of a failure in financial markets for R&D (Arrow, 1962). However, because financial institutions do not tend to lend the necessary resource to firms as R&D is too risky, this ‘reimbursement structure’ of the programme does not serve as a mechanism for enabling firms to undertake R&D that would not be otherwise undertaken because of financial difficulties. In contrast, it functions as a reward mechanism for the firms that have already undertaken R&D.

50 The programme was later renamed as TUBITAK-TEYDEB
This structure was prevalent in the years when high level of inflation was evident in Turkey\textsuperscript{51}. Taking into account that time consumed for overcoming the red-tape could reach up to 6 months on some projects, the firm could get the money it disposed almost a year ago. This means that in some cases the firm was able to reimburse only the half of the money in real terms agreed on the contract. Therefore, this structure can be considered not as an R&D grant programme but a non-steady implementation of a R&D reimbursement programme.

9.3.2. Case A.1: Componenta Doktas

9.3.2.1. Characteristics of the Firm

Location: Manisa, Turkey

Manisa is an industrial city close to west coast of Turkey with good connections to the nearby Izmir port, one of the largest ports in Aegean Sea.

Size: Large-sized

There are about 2000 employees in Turkey, €185m sales in 2007.

R&D Experience: Experienced R&D performer

Openness: Very Open

MNC Mostly Exporting (60% - 70%)

Complex horizontal and vertical relationships particularly in the automotive sector

Type of Innovation: Mostly Process R&D

Technology Intensiveness: High

Sector:

- D - Manufacturing
- DJ.27.50 - Casting of metals
- DJ.27.51 - Casting of iron
- DJ.27.52 - Casting of steel
- DJ.27.53 - Casting of light metals
- DJ.28.40 - Forging, pressing, stamping and roll forming of metal; powder metallurgy

Firm Description: Founded in 1977, Doktas is one of the biggest aluminium and iron foundry firms in Europe. It mainly produces aluminium and iron automotive parts such as engine blocks and wheels. It used to be a part of the biggest conglomerate of Turkey, Koc Holding, which also

\textsuperscript{51} The annual rate of change of producer price index was higher than 75% for the years 1995, 1998 and 1999 and higher than 50% for the years 1996, 1997 and 2001.
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Jointly owns Ford and Fiat factories in Turkey. Koc Holding considered Doktas as an important complement to their automotive sector investments for a long time before it was acquired by a Finnish firm, Componenta Oyj, after Koc Holding fell short of cash and decided to focus on some strategic sectors in 2006. Componenta and Doktas were similar in size before the acquisition and now their joint value is estimated at around half a billion USD. Both firms are publicly-listed in their domestic countries, in Istanbul Stock Exchange and Helsinki Stock Exchange, respectively.

As the firm was already producing far more efficiently than the industry average, the acquisition did not result in a significant change in the firm structure, including the top management. Integration between the counterparts, moreover, has mostly been established during 2007.

Although Componenta and Doktas have essentially been producing the same general product, their sectors of focus do not overlap - Componenta Oyj supplies the heavy trucks and off-road vehicles industry while Doktas produces parts for the automotive industry.

Doktas has two sites in Turkey: an aluminium foundry in Manisa plant and an iron foundry in Bursa (Orhangazi) plant (south of Istanbul, the city where almost all the automotive industry is located). Their headquarters in Turkey is located in Bursa while the R&D Management is based in Manisa.

After the merger, Doktas has been trying to convince Componenta to move the entire R&D infrastructure and efforts to Turkey (mainly to Manisa) plant as it is far more experienced than its Finnish counterparts in innovation and R&D performing. This intention has recently been communicated with the headquarter (Helsinki) and initially warmly received.

Interviewee(s):
- Mr Can Demir, Componenta Doktas Quality Systems and R&D Manager
- Ms Elvan Bilge Mentese, Doktas R&D and Quality Assistant Manager
- Mr Sinan Varol, Manisa Foundry Business Unit Director

R&D Organisation: According to TUBITAK-TIDEB Programme figures, Doktas is ranked as the 10th firm according to the number of projects that the programme supported. Considering the tendency that the programme supports more technology intensive companies, this could be considered as a success.

The practice of undertaking R&D activities as proper projects is integral to this success – all of the R&D activities of DOKTAS were designed and managed as separate projects. This practice, however, has some disadvantages as well. As R&D activities are considered as separate projects, the R&D department has no other staff apart from the managers (total of 3-4 FTE). Generally, these projects are carried out in collaboration with other departments of the firm, whereby the
relevant staff in these departments acts as R&D staff during the life span of a particular R&D project. Another disadvantage associated with this structure is that the planning of the R&D activities tends to be very shortsighted as the staffing needs of other departments play a significant role in the resource allocation.

R&D projects generally stem from a perceived opportunity within the usual operations. Most often, R&D projects are conducted over more than one year. Moreover, most R&D is incremental and process based although there are some exceptional cases of radical R&D, product R&D and both.

R&D projects of Manisa and Bursa plants are not interconnected as most of the projects are project-based process R&D activities. However, there are a few examples that both plants are involved together.

Excluding the product design activities, some part of which can be classified as R&D, the R&D intensity is 2%.

Amongst various projects that were supported by TUBITAK-TIDEB programme, the following two projects were selected to be analysed in detail in agreement with Mr Demir.

9.3.2.2. Crack Analysis Project

Problem: An injection press, a key machine for die-casting, operates with 4 huge pistons. These huge pistons wear down by time and eventually break down. Besides being very expensive, replacement of these pistons takes 4-8 hours. A breakdown in pistons damages the other parts of the machine and often leads to unsolicited stops in the production line. The factory has about 18 of these piston-operated machines and they play a key role in the production.

The firm was not sure about the reason of the cracks and breakdowns. There were competing beliefs of misuse, a possible malfunction in the machine, low quality of pistons and finally simply wearing out.

Motivation: The former General Manager, Mr. Yaylali Gunay, read a technical article about the developments in ultrasound technology and their industrial applications. He recommended that the R&D department try that avenue. The original idea was to monitor the cracks in pistons and build a model to estimate the time of breakdown by using ultrasound devices. The project was conducted in the Manisa plant and the Bursa plant also played a role.

Research: In line with the General Manager’s initial idea, an ultrasound device was planned. The firm first borrowed an ultrasound device that was in use in the Orhangazi plant for another purpose. The R&D manager in Orhangazi plant (Bulent) himself visited the factory and used the device himself. In collaboration with an ultrasound use licensed local firm, NDT, Componenta...
developed a prototype mobile device that reveals the status of the crack in pistons without hindering the production. The firm discovered that the cracks and breakdowns occur simply because of wearing down. Furthermore, they devised a model to estimate the breakdown in the further stages of the crack and discovered that 50% crack is threshold. The firm further devised a routine to monitor and analyse the crack and when necessary to take corrective action. Moreover, the firm discovered that at a certain level of crack, a special repair procedure could be utilised to increase the time that the piston could be used before a breakdown.

Aftermath of the Project: Once the firm realised that an ultrasound device can be used to solve the emergent problem, they bought a special mobile device. This device is now being actively used in the factory. Similarly, the model and the routine developed in the project are in regular use in both Manisa and Bursa plants. Furthermore, they are using this device and benefitting from the idea of monitoring object with ultrasound principle in the other areas of the production. Besides, as they produce aluminium parts, in some cases they investigate the quality of the final product by using this technology.

An interesting consequence of the project is that the academic referee who was appointed by TUBITAK to oversee the project changed his line of study after that project.

Additionality of the Project: The firm would not have undertaken the project in the same size and fashion without the government support. High input and output additionality, and medium behavioural additionality are experienced.

9.3.2.2.1. Behavioural Additionality of the Project

Performance: They developed a model of crack, which would lead to increase in productivity.

Capabilities: They gained the capability of using ultrasound in the production process.

Changes in the way the firm would have conducted the project: Had there been no support, the firm would have simply borrowed the ultrasound device and tried it. However, without the model the firm developed exclusively due to the programme, these trials would have been fruitless and the firm would not have increased their performance.

9.3.2.2.1.1. Routine A.1.1. Testing Cracks with Ultrasound

They have developed a new routine of testing cracks with ultrasound. Had there been no support, this routine would not have been developed.

Government support reinforced the ostensive and performative aspect of the routine. Had there been no support, the firm would have had the artefact only (the ultrasound device is borrowed from the other plant). However, the firm developed the crack model, which contributed to their
understanding of how the firm should conduct the test (ostensive aspect) exclusively because the firm were supported by the programme. Similarly, the performative aspect was reinforced as the firm performed the routine a number of times during the project.

Consequences:
- **Economising Cognitive Resources/Reducing Uncertainty**: They decreased the risk of cracking and unwanted stops.

9.3.2.1.2. Routine A.1.2. In-house R&D Collaboration

They developed a routine not to collaborate with the other plant unless it is absolutely essential because of the experience the firm had with them. The government support allowed them to normalise this routine and legitimise it within the firm.

Consequences:
- **Economising Cognitive Resources/Reducing Uncertainty**: The firm has decreased the risk of potential conflict.
- **Coordination and Control/Truce**: The firm has decreased the risk of potential conflict.

9.3.2.3. Thermal Process Project

**Problem**: The firm had supplied an aluminium part of an engine for Ford Turkey factory before Ford changed its engine design from 4 cylinders to 5 cylinders. Ford required Doktas to produce a compatible aluminium part. Doktas undertook the design and prepared a prototype to be tested in Ford. This part was compatible with the new 5-cylinder engine, however, failed in the test as it cracked under certain stress. All efforts on Doktas’ side to fix the emergent error by changing production parameters proved to be useless.

**Motivation**: In the further stages of the crisis, Ford Europe claimed that the crack could arise from the tension in the thermal process the firm use in the production of the particular part.

**Research**: As the product was to be used in a new Ford automobile as a key part that could delay the production, the project was carried out in close collaboration with various Ford plants including Ford Turkey, Ford Germany and Ford USA. Particularly, the computer simulations on the pressure levels during the thermal process were done by Ford Germany. Finally, the firm decided to use polymer added water in thermal process instead of pure water. They also contracted a research institute of TUBITAK for tests and analysis.

**Aftermath of the Project**: Production technique as well as product specifications changed completely with new process based on a technique of polymer watering. A couple of scholarly articles were produced. They developed the routine of working with other partners in R&D
projects after this particular project. Moreover, the project opened up the window for working with TUBITAK’s research institutes.

**Additionality of the Project:** The firm would have undertaken the project more or less in the same size without the government support anyway. No or low input and output additionality but medium behavioural additionality were experienced.

### 9.3.2.3.1. Behavioural Additionality of the Project

**Performance:** The firm has solved the problem and saved their contract with Ford.

**Capabilities:** The firm gained the capability of working with thermal process. All the experiments within the R&D process accumulated to an extensive base of knowledge within the firm applicable to a wide variety of products. For instance, although this project was only concerned with the temperature of the liquid used in the process, the firm gained a wider understanding of the thermal process that they applied to the ovening process as well.

At a critical stage, the firm had to choose an appropriate additive for water. They could continue with water only, which would be cheaper but more difficult to solve the problem and thus more risky. The second option would be using polymers as additives, which would be more expensive and this would require more research as the firm have not had any experience. However, this would be less risky as the firm knew using polymer would potentially be very effective. TIDEB funding enabled them to choose the latter option that proved to be very effective at the end. Because the firm chose polymer, it changed the following routines.

**Changes in the way the firm would have conducted the project:** Mr Can Demir said “Had the project not been supported by TIDEB, we would not have included polymer to the process. Consequently, we would not have known the root cause of the problems and we would have tried to remedy symptoms with superficial solutions, just palliatively. Therefore, we would not have changed our routines this much.”

Had there been no support, the firm would have been less analytical in general. He added, “We would have done it first, then we would have thought”. They did it in a more analytical way to be able to convince the academic advisor, which in turn have proved more efficient.

### 9.3.2.3.1.1. Routine A.1.3. Controlling the Temperature of Water

They realised the water temperature is critically important and kept the water temperature between 45 and 55 degrees. Doktas built a new tank and cooling unit for water-polymer mix that was used for every product within the firm (a new artefact). The firm has devised a new written procedure, which includes a batch control mechanism.
Had there been no support, the firm would not have the change in this routine (at least not in this extent). As the government support allowed them to be more analytical, the ostensive aspect of the routine was reinforced by encouraging them to discover the importance of keeping the water temperature at a certain level (thus changing the cognition of the people involved). The artefacts (the new tank, the cooling unit and written procedure) did not change as the firm would have bought/created them anyway. The performative aspect would not have changed either.

Consequences:
- **Economising Cognitive Resources/Reducing Uncertainty**: Previously the firm would treat temperature as a blanket explanation for various other failures. However, the firm now realise the extent of its consequences and can focus on other problems that the firm now know are not caused by the water temperature.

### 9.3.2.3.1.2. Routine A.1.4. Designing Baskets and Stacks

They devised a stacking design whereas the firm were not used to have any order for the basket they put the materials into. They devised a very detailed and novel written procedure (with photos), which includes a batch control mechanism. They started to design baskets as well. This was initially done for the product they were experiencing the cracking problem with. However, they realised that it is important and started to design baskets for all products in the firm.

Government support contributed to all three aspects of the routine, albeit in a small extent.

Consequences:
- **Coordination and Control/Truce**: Engineers used to review the stacking to avoid any possible mismatch. This was a particular problem, as engineers do not work in night shifts and workers used to do mistakes in stacking. This has been an issue of tension between workers and engineers. However, the new design has provided coordination in this respect and truce.

- **Economising Cognitive Resources/Reducing Uncertainty**: It takes less time to process materials because of a particular design in stacking. This has decreased the fault ratio and therefore decreased uncertainty for low quality. Similarly, engineers can spend more time on other things as they do not have to spend time on controlling the stacking.

- **Learning/Stability**: They also learnt a way of designing baskets. It used to be very thin before the project. However, the requirements of the project required a new design for the basket itself, which also decreased the fault ratio.
9.3.2.3.1.3. Routine A.1.5. Conducting Polymer Experiments

They started conducting polymer experiments for cracks and deformations for all the prototypes thermally critical designed thereafter.

In a consequent project called swing bed, because they had the routine of experimenting with polymer in the prototype phase, they gained significant time and money by detecting a possible crack that would have been detected by the client.

Had there been no support, they would not have created this routine. The government support changed the ostensive (by encouraging people to gain more knowledge about polymer), and performative (by allowing them to perform this routine within sufficient amount of times within the R&D process) aspects.

Consequences:

- **Economising Cognitive Resources/Reducing Uncertainty**: Positive impact was observed since they did not have to devote resources to analyse the causes for possible cracks.

- **Learning/Stability**: As they have learned the process of using polymer and experimenting with different substances, a new project required only 2 experiments. Normally, they would do 10-15 experiments, which meant comparatively very high costs.

9.3.3. Case A.2: Atikus

9.3.3.1. Characteristics of the Firm

**Location**: METU Teknokent, Ankara

The firm is located within a university science park in Ankara, Turkey. The size of the physical space is around 50m².

**Size**: Micro-sized

Two partners worked together. One of the partners continued his PhD at the university where the science park is based in.

**R&D Experience**: Very experienced R&D performer

The firm’s main business is design and R&D.

**Openness**: Moderately Open, Moderate degree of import and export
They have mainly been working in the internal market with occasional import. They have high degree of direct import relations.

Type of Innovation: Product Innovation

Technology Intensiveness: Very High

Sector:
- C28.9.4 - Manufacture of machinery for textile, apparel and leather production
- C13.9.3 - Manufacture of carpets and rugs

Firm Description:
Atikus is a micro sized firm founded in the mid-1990s by two engineers. It is located at the science park of the Middle East Technical University (METU) where both of the partners completed a BSc in Electrical and Electronics Engineering.

The firm specialises in the design of the electromechanical parts for various purposes.

The firm, in its foundation, was incubated shortly by KOSGEB (SME development agency) again in METU Teknopark.

As one of the partners is pursuing PhD in the Electrical and Electronics Engineering in METU, the firm has very good connections with the university.

Interviewee(s):
- Mr Ali Ilhsan Aslan, partner

R&D Organisation:
The firm is a micro organisation hosting two engineers. It is a research driven organisation by definition, as the firm’s main area of operation is design-by-innovation. The firm’s R&D efforts are mostly opportunity driven, as there are no resources within the firm to conduct blue-sky research.

9.3.3.2. Carpet Knotting Machines Modernisation Project

Problem: Turkey has quite outdated carpet machinery stock while the demand for carpets within the country and also from abroad has consistently been increasing. Most of the current machinery, which are used by small producers, can only knot carpets with simple patterns while they are not capable of knotting carpet with more complex designs. They mostly used an outdated cartridge system, which is very inflexible. Large producers, however, use modern machines that can produce a given pattern in the form of a JPEG image file.
The interviewee explained that the conventional machines would cost USD50,000 and would produce half of what the modern machines produce, while modern machines would cost around USD1,000,000.

**Motivation:** Complete replacement of the machine inventory was very costly and devising a way of upgrading the underperforming and outdated machinery portfolio promised a unique opportunity. The cost of modernisation would be around USD50,000 per unit, which is still well below the alternative equipment.

**Research:** They researched a design of small and mobile computer with an electro-mechanic interface to conventional carpet machines. This new machines would be capable of converting the outdated machinery to a standard of producing and jpeg pattern in micron tuning. The project ran from 2002 to 2003 (18 months) and its total cost was 60 man/month plus USD200,000. Atikus worked with another firm in a setting that all the electro-mechanic components were designed by Atikus whereas partner was responsible of developing the software required.

**Additionality of the Project:** They would not have undertaken the project in the same size and fashion without the government support anyway. Medium input and output additionality, medium behavioural additionality.

**9.3.3.2.1. Behavioural Additionality of the Project**

**Performance:** They developed a design and prototype for an electro-mechanical interface for the outdated carpet machines. Consequently, they converted a number of carpet machines in Turkey and Iran (total revenue of over USD1,500,000) and therefore increased their profitability substantially.

**Capabilities:** They mastered upgrading of conventional carpet machinery.

**Changes in the way they would have conducted the project:** The project would not have been as analytical as it was without the government support.

**9.3.3.2.1.1. Routine A.2.1. Sourcing Key Components**

At the beginning of the project, they sourced a key component, piezo-ceramics, from a Chinese supplier. However, this piece was very unstable and had a very negative effect on the preliminary tests. When they realised the problem about this component, they tried to source it from other Far East suppliers. However, the problem persisted until to a point where the whole project was in jeopardy. They, then, decided to try an industry gold standard piezo-ceramics produced by a German supplier. This particular product was significantly more expensive than the other ones they tried and failed.
The increase in costs was objected by one of the partners, who is very cost-conscious. This incident actually surfaced an underlying problem within the firm: one of the partners has always been focusing on the overall costs while the other one has been insisting that they should use higher quality components, at least in the prototype phase.

The component they supplied from Germany produced spectacular results. As a consequence of this incident, the tension between partners were settled and they started to use highest quality components at least in the research phase.

Had there been no support, they might have conducted the project anyway, most probably in a smaller scale. However, they could not have afforded to use German made piezo-ceramics and consequently they would not have changed their sourcing of critical components routine. The government support mutated the ostensive dimension of this routine.

Consequences:

- **Coordination and Control/Truce:** With the mutated routine a key tension between the two partners was resolved.

- **Economising Cognitive Resources/Reducing Uncertainty:** The new mutated routine decreased uncertainty and gave the partners the opportunity to focus on other issues.

9.3.3.2.1.2. Routine A.2.2. Project Planning

As the project required a very structured project planning with financial planning and time planning with gantt charts, they have performed the routine of making very structured project plans at the beginning of each project one more time. This reinforcement to the performative aspect led to further adoption of this routine which is now normalised within the firm. Due to this routine, they were selected as a designer by another firm, which was very selective for this capability in its subcontractors. Had they have not been supported by the government, the routine could not have been adopted.

Consequences:

- **Learning/Stability:** Routinisation of project management brought further stability.
### 9.3.4. Case A.3: Firm A.3.\(^{52}\)

#### 9.3.4.1. Characteristics of the Firm

**Location:** This information has been excluded to anonymise the firm.

**Size:** Small/Medium-sized

40-60 employees, a subsidiary of a large conglomerate

**R&D Experience:** Experienced R&D performer

**Openness:** Moderately Open, Moderate degree of import and export

**Type of Innovation:** Product and Process Innovation

**Technology Intensiveness:** Very High

**Sector:**
- D – Manufacturing
- DK.29.00 - Manufacture of machinery and equipment n.e.c.
- DK.29.10 - Manufacture of machinery for the production and use of mechanical power, except aircraft, vehicle and cycle engines
- DL.0.00 - Manufacture of electrical and optical equipment

**Firm Description:**
Firm A.3. was founded in early 1990s as a start-up. The firm was acquired in 2001 by one of the big conglomerates very active in defence industry in Turkey. However, Firm A.3. is still managed by its founder. The firm is well experienced in mechatronics and robotisation, it is specialised in providing robotised automation systems for manufacturing firms, especially the automobile industry. It recently focuses on the defence industry.

The firm has exceptional infrastructure and facilities compared to its size.

**Interviewee(s):**
This information has been excluded to anonymise the firm.

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\(^{52}\) The firm has been anonymised at its request.
R&D Organisation:

As a firm that produces high technology products, Firm A.3. is an experienced R&D performer. It has engaged in various R&D projects funded nationally and internationally. The firm has a special emphasis on Framework Programmes and a faculty in Istanbul Technical University is responsible for these kinds of engagements.

9.3.4.1.1. Behavioural Additionality

As Firm A.3. is mainly involved in highly classified military projects, the details of the projects are not allowed to discuss in detail. However, a number of projects were discussed and some general conclusions relevant to this case study were derived.

9.3.4.1.1.1. Routine A.3.1. International R&D Collaboration

As a very high tech firm, Firm A.3. is one of its kind of in Turkey. It has already exploited collaboration opportunities with various other partners in the country and it felt it needed to collaborate in R&D with overseas firms. However, the management of the conglomerate they are part of was quite sceptical about this kind of collaboration with the concern that it might damage their relationship with the military, which is overly sensitive about confidentiality.

The support they received from TUBITAK has created no input or output additionality. They say they would have conducted the projects anyway. However, the TUBITAK support created slack resources that created an opportunity for Firm A.3.‘s top management to convince their counterparts in the parent group. It was argued that the slack resources that the TUBITAK support generated could be used to minimise the risk of not getting a number of military contracts in case they involve in international cooperation. Consequently, they employed a university professor as the head of international R&D cooperation. Within 4 years, they were involved in three different EU framework projects in which they developed unique capabilities and networks. Therefore, the government support created the routine of international R&D collaboration by creating an ostensive aspect to it.

- **Learning/Stability:** The routine has provided the stability of conducting regular R&D.
9.3.5. Case A.4: Muradoglu

9.3.5.1. Characteristics of the Firm

Location: Umreniye, Istanbul

An industrial district of Istanbul

Size: Small-sized

5-10 Employees

R&D Experience: First-time R&D Performer

Openness: Not Open, does not have any significant import or export

Type of Innovation: Process Innovation

Technology Intensiveness: Low

Sector:
- C10.8.3 - Processing of tea and coffee

Firm Description:

Muradoglu Teas is a director-owned firm. Mr Mustafa Aziz Muradoglu is originally from the north-eastern part (East Black Sea Region) of Turkey, where the tea production is based. He established his business in Istanbul in early the 1990s when he migrated from that region to Istanbul. The firm mainly buys processed tea from East Black Sea Region (including its own limited plantation) to add a Earl Gray aroma. Then, the final product is packaged and branded as Murpa Tea.

The firm is located in a small-sized warehouse building in Istanbul and operates with less than 10 people.

Interviewee(s):
- Mr Mustafa Aziz Muradoglu, General Director

R&D Organisation:

The firm had no R&D experience prior to the project supported by the TIDEB Programme.

9.3.5.2. Microwave Tea Treatment Project

Problem: Although Turkey is the fifth biggest tea producer in the world, the barriers in trade keeps the quality of Turkish tea relatively low compared to other big tea manufacturers’ products. Apart from the low quality of the tea leaves, traditional methods employed in the
manufacturing of tea decreases the quality of the end-product even further. After the tealeaves are plucked, generally a process that includes withering, rolling, fermentation, drying and sorting is employed. Withering and drying processes are needed to extract the moisture in the tea and they are conducted by heating the tealeaves in fan-assisted, coal-operated industrial ovens. However, as this process is very sensitive, any mistreatment causes a change in the taste of the tea, the production of anti-oxidants and thus decreases the quality of the final product. Furthermore, costs associated with these ovening processes represent the majority of the manufacturing costs.

Motivation: The owner-director thought a microwave oven could be used for withering and drying. Although he does not have a technical background in the relevant field, he developed a personal interest and began to research the issue. He discovered a true potential for conducting an applied research in the field, however, postponed it for some time due to the lack of funding. Consequently, he realised he could apply for TIDEB support.

Research: The use of microwave technology to extract the moisture of tea in the manufacturing process was the focus of the project. The whole project is supported by the TIDEB programme in the form of smaller sub-projects at different times. The total budget is around quarter million pounds.

Aftermath of the Project: After the research proved a potential use for the method, the firm applied to an R&D loan agency, TTGV and was granted a loan for building a pilot plant. While the firm built a small pilot manufacturing plant in the Black Sea Region, it needed additional capital to operationalise it. However, the owner-director of the firm reports that an international beverage giant (Coca Cola), which was about to enter the Turkish tea market, was interested in the technology for its prospective manufacturing operation in Turkey. It was reported that the multinational firm rented the pilot plant for further tests as of the date of the interview.

Additionality of the Project: The owner-director stated that the project would not have been conducted on this scale if it was not supported by the programme. Similarly, he argued that the final result would not have been created.

9.3.5.2.1. Behavioural Additionality of the Project

Performance: The firm has developed a novel way of processing tealeaves by using microwave technology. They have the prospect of selling this technology to a tea-manufacturing giant.

Capabilities: The firm mastered the use of microwave technology in tea production process.

Changes in the way they would have conducted the project: Without the government support, they would not have been analytical at all.
9.3.5.2.1.1. Routine A.4.1. Manufacturing Tea

The microwave process has changed the sequence of the process of tea manufacturing. The process originally started from withering and continued with, rolling, fermentation, drying and sorting. The microwave process lifted the requirement for fermentation to most extent and the way it is rolled changed so that tea is also rolled after drying. Had there been no government support, the firm could not have employed a food engineer who influenced these decisions directly. Therefore, the support originated a routine by recombination by creating an ostensive aspect that was missing in the firm.

Consequences:

- Learning/Stability: This routine brought a stable quality in the final product through the learning of the process it provided.

9.3.6. Case A.5: Ozcelik Makina

9.3.6.1. Characteristics of the Firm

Location: Gaziantep, Turkey

This is a mid-size city in South Eastern part of city.

Size: Mid-sized (around 50 employees)

R&D Experience: High

Openness: Open (they mostly export their products)

Type of Innovation: Product Innovation

Technology Intensiveness: Medium

Sector:

- C25 - Manufacture of fabricated metal products, except machinery and equipment

Firm Description:

Mr Mennan Aksoy had been running a machine repair service in an industrial zone mostly inhabited by other small and micro-sized firms. When he started his business in 1973, the firm was micro-sized (himself and a few employees).

The firm was one of the first firms that were funded by the programme (around 1995). Although they had no experience in R&D, nor any technical education, they applied for the support with
the help of a university professor who consequently became a partner at the firm. Ozcelik Makina is the leading beneficiary of the programme in terms of the number of projects supported (around a dozen, almost one for each year). In fact, Mr Aksoy indicated that there was no year since 1995 that the firm was not supported by the programme in some way or other. Mr Aksoy argued that thanks to their R&D activities, his firm grew 250 times from 1995 to 2007.

Thanks to TIDEB support, Mr Aksoy mastered reverse engineering and produced dozens of previously imported textile machinery for which he foresaw a market. Mr Aksoy became a public figure. The press called him as a “genius inventor”, TUBITAK and the local politicians announced him as a success story (Atay, 2006; Ozdemir, 2003).

Interviewee(s):

➢ Mr Mennan Aksoy

R&D Organisation:

The firm is an R&D organisation. 90% of the staff are technical and non-technical staff are also devoted to support the R&D process. According to the Frascati Manual definition, all of the staff are classified as R&D personnel.

9.3.6.1.1. Behavioural Additionality

As the firm has been supported in numerous instances by the TIDEB programme, this case will be analysed in a general sense.

Performance: The firm designed a number of machines.

Capabilities: The firm mastered reverse engineering.

Changes in the way they would have conducted the project: Without the government support, they would not have conducted any of the projects.

9.3.6.1.1.1. Routine A.5.1. Conducting R&D

The firm developed a few dozen machines with TIDEB support. Mr Aksoy argued that all of these machines are at least threefold cheaper than their alternatives mostly imported. However, it was revealed that the firm has never managed to sell significant numbers of these machines. Mr Aksoy pointed out that they sold 30% of the machines they produced and most them were sold only a few times. Furthermore, for those machines it sold, it made a significant loss as they did not have a proper after sales service although they offered it while selling their products to be able to compete with the overseas rivals which are mainly famous for their reliable after sales services. Almost half of the machinery they sold was eventually returned due to this reason.
The firm fell into a competency trap that is discussed in Chapter 5. The best thing they did was to apply for TIDEB support and design a machine by reverse engineering. The main way of raising money for the firm was to apply for TIDEB funding. They invested in the routines they did best but failed to improve their routines related to the other areas of the value chain (e.g. marketing, after sales services, etc.).

The government support created a big constellation of a routine of conducting R&D by creating ostensive (the idea of conducting R&D), performative (each of the projects supported by TIDEB) and artefact (the physical resources provided by the programme) aspects of this routine. The firm would never have engaged in R&D had there been no TIDEB support. However, this routine of conducting R&D became the source of a negative feedback loop because of the competency trap discussed above. As the firm performed more R&D, it lost money and to be able to finance its loss, it applied to government funding by conducting more R&D. Their loss has become bigger and bigger by time. Government support created a large routine of conducting R&D but also migrated this routine to the other parts of the firm to the extent that it suppressed everything else within the firm.

Consequences:

- **Learning/Stability**: This routine limited the learning while it provided a false stability.

- **Economising Cognitive Resources/Reducing Uncertainty**: This routine mis-economised the cognitive resources as it repressed everything but research and therefore increased uncertainty.

### 9.3.7. Case A.6: CEKA

#### 9.3.7.1. Characteristics of the Firm

**Location**: Gaziantep, Turkey

This is a mid-size city in South Eastern part of city.

**Size**: Micro (the owner, his son and up to 5 more employees)

**R&D Experience**: None

**Openness**: Not open

**Type of Innovation**: Mostly product innovation

**Technology Intensiveness**: Low
Sector:
- C25 - Manufacture of fabricated metal products, except machinery and equipment

Firm Description:
CEKA was founded by Mr Celal Kalender 30 years ago. They have been operating as a micro firm located within the industrial zone occupied by other small or micro firms. Their main field of activity was the repair of the machinery for neighbouring firms while they even had to repair cars or household good during the times of crisis.

The firm has no experience in R&D and neither the owner nor his son who is working with him or any other employees have any other technical education.

Interviewee(s):
- Mr Celal Kalender

R&D Organisation: No formal R&D experience and organisation.

9.3.7.2. Slipper Machine Project

Problem: Mr Kalender participated in a TUBITAK workshop organised in Gaziantep that marketed the TIDEB programme. He had no experience in R&D but the workshop convinced him to research the programme further. He said he thought “R&D is for university people, not for us who are only machine repairers”. Furthermore, one of his neighbours (Ozcelik Makina, the previous case) had successfully received funding from the programme. Consequently, he approached a university lecturer at the local university to build a machine that could be supported by the programme.

Motivation: He realised that there is a potential for building a machine for producing polyurethane slippers as it is quite popular in the region, which is the hottest part of the country. He also thought the machine and the end-product could easily be sold in the Middle East where Gaziantep is very close to. His market research revealed that polyurethane slippers were imported from China as the machinery to build them was not produced in Turkey and therefore there is a market for polyurethane slipper machine.

Research: They designed a machine that could produce polyurethane slippers. They also built a few prototypes for different kinds of products.

Aftermath of the Project: The firm sold a number of machines within Turkey and to the Middle East. They also built other machinery in other areas.

Additionality of the Project: Very high input, output and behavioural additionality.
9.3.7.2.1. Behavioural Additionality of the Project

Performance: The firm designed a polyurethane slipper machine.

Capabilities: The firm gained capability of designing and producing machinery on their own.

Changes in the way they would have conducted the project: Without the government support, they would not have conducted the project and remained as a repair service.

9.3.7.2.1.1. Routine A.6.1. Using CAD Packages

Prior to the project, the firm had an extensive repair experience with a variety of machinery. They used to disassemble the machinery randomly and without any analytical order. During the project, the project officer and their academic consultant introduced a computer to them which they learnt CAD packages. The project officer required them to draw detailed technical pictures. In fact, Mr Kalender’s son received 3 months’ training paid by the programme. Consequently, they began using CAD packages in their further works. The government support created all three aspects of the routine: it created an awareness about CAD (ostensive), it provided the computer that they could use CAD (artefact), and it required they use CAD in the project (performative).

Consequences:

- **Learning/Stability:** This routine brought a stable quality in the production stage and represented the learning.
- **Coordination and Control/Truce:** This routine provided a more coordinated production phase.
- **Economising Cognitive Resources/Reducing Uncertainty:** This routine reduced the uncertainty of possible failure arising from the possible flaws of manual drawing.
9.4. Case Study B: British Collaborative R&D (CR&D) Programme

9.4.1. Characteristics of the Programme

Target Audience: All firms and academic unit are eligible for support in the CR&D programme

Definition of R&D and Innovation: Definition of R&D and innovation are compatible with OECD Frascati and Oslo framework. Furthermore, the programme only supports “very risky” R&D (Deeley, 2010).

Support Basis: Like the TIDEB programme, the support for R&D is on a grant basis. The maximum amount that could be supported by the public funds was 50% of the project budget as per EU and WTO regulation.

Support Duration: Projects of up to 5-year span could be supported while most projects are 36 months long.

Modalities of the Programme: Unlike the TIDEB programme, CR&D is a top-down programme. The programme is managed by a quasi-public organisation (quango) called Technology Strategy Board (TSB), which runs a series of similar programmes. TSB issues a call in a specific technology area (e.g. “tools that will enable a dramatic improvement in the design of predictability zero carbon and low impact buildings”). Consequently, firms form a consortium with other firms or universities to apply to the call.

Additionality is a fundamental criterion for the selection. Consortiums are required to prove why the project would not have happened without the support.

The programme management is more reserved in terms of their interaction with the beneficiaries compared to the TIDEB programme. While in the TIDEB programme, the role of the project officer is to oversee the programme technically as well as monitor the proper conduct of the support procedure, the latter is the only role of the CR&D project officers. Similarly, in the TIDEB programme there is an assigned academic, who supports the beneficiaries, while there is no such person in the CR&D programme.

On the other hand, the monitoring system is much more rigorous and structured for the CR&D programme. Consortiums should input their financial and project management data almost in real time. Similarly, the rule enforcement is much harsher.

Finally, the programme is very dynamic. The monitoring system changed at least four times since the programme was launched in 2004. Furthermore, the programme is much more flexible than
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the Turkish one. There is a separate monitoring process for small projects or smaller consortiums while TIDEB programme’s modalities are mostly in the form of one size fits all.

9.4.2. Case B.1: Smith & Nephew

9.4.2.1. Characteristics of the Firm

Location: York

The York site is devoted to research and located within the University of York

Size: Large multinational pharmaceutical firm

The whole firm employs around 9000 people while the York site hosts around 120 scientists

R&D Experience: Very High

Openness: Very open multinational firm

Type of Innovation: Product and process innovation

Technology Intensiveness: Very high

Sector:
- C21 - Manufacture of basic pharmaceutical products and pharmaceutical preparations

Firm Description: Smith & Nephew is a large pharmaceutical firm whose headquarters is located in the US.

Interviewee(s):
- Dr Nicola Macauley
- Dr Rob Morgan
- Dr Rachel Hanson

R&D Organisation:
The firm has a number of research sites in the US and in York, UK. The firm has a complex research organisation in which there is a high degree of competition between different sites. Similarly, the organisation of R&D changes very frequently both firm wide and within the York site.

9.4.2.2. Bioreorbable Composites Project

Problem: Bone fractures are often treated with invasive metal implants. However, removal of these types of implants are difficult and costly while especially children would need them to be
removed for their bone development. One solution to overcome this problem is to use bioresorbable material so that the implants dissolve in the body when they complete their function.

Motivation: The current range of bioresorbable materials are either too weak to hold bones together or too strong to dissolve in time. Smith and Nephew saw the opportunities that further research could bring.

Research: Producing better bioresorbable composites together with a small equipment supplier located in York (FET). Smith and Nephew had a long-running relationship with FET.

Additionality of the Project: Low input, output and behavioural additionality.

9.4.2.2.1. Behavioural Additionality of the Project

Performance: The firm designed a better bioresorbable composite.

Capabilities: The firm gained the capability of designing a better bioresorbable composite that can be applied to a wide range of scenario.

Changes in the way they would have conducted the project: Without the government support, they would have conducted the project less ambitiously and in a smaller scale.

9.4.2.2.1.1. Routine B.1.1. Controlling Storage Conditions

Because of TSB’s support, the firm had resources and the opportunity to conduct more research on the storage conditions of the material developed. They realised that moisture is a key parameter and studied the conditions under which moisture is optimised. Had there been no support, the consortium would not have studied this issue to this extent.

The findings on the moisture level created a routine to control the storage conditions of the material both in development and sale stages. This routine has also been disseminated to other parts of the firm. The government support created the ostensive and performative dimensions of this routine.

Consequences:

- **Learning/Stability:** This routine represents the learning that they accomplished.

- **Economising Cognitive Resources/Reducing Uncertainty:** Because they control a key variable (moisture) and therefore decreased the risk of failure, they can divert their attentions to other conditions.
## 9.4.3. Case B.2: Rolls-Royce

### 9.4.3.1. Characteristics of the Firm

**Location:** Derby  
**Size:** Large  
**R&D Experience:** Very High  
**Openness:** Very High  
**Type of Innovation:** Product and Process Innovation  
**Technology Intensiveness:** Very High

**Sector:**  
- C27.1 - Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus  
- C29 - Manufacture of motor vehicles, trailers and semi-trailers

**Firm Description:** A very large British firm that specialises in the production of aerospace engines at the moment.

**Interviewee(s):**  
- Mr Colin Small

**R&D Organisation:**  
A complex and hierarchical R&D organisation. The materials department that was mandated to do research on materials was interviewed.

### 9.4.3.2. Materials for Arduous Cycle and Emissions Project

**Problem:** Due to the very intense competition in the aerospace engine sector, the firm continually needs to improve the material they use in their products.

**Motivation:** They wanted to develop a new material that would be more resistant to high temperature and therefore be more fuel efficient.

**Research:** Together with 4 university departments and 2 industrial partners they researched three different materials.

**Additionality of the Project:** Low input, output and behavioural additionality.
9.4.3.2.1. Behavioural Additionality of the Project

Performance: The firm designed a new compressor abradable for operation up to 600°C, a new sulphidation resistant Ni-disc materials and coatings for operation at 730°C and a novel single crystal blade technology.

Capabilities: The firm gained capability of designing better materials.

Changes in the way they would have conducted the project: Without the government support, they would have conducted the project less ambitiously and on a smaller scale. Similarly, they would not have worked with some of the partners, which turned out to be effective.

9.4.3.2.1.1. Routine B.2.1. Project Reporting

The project was conducted by the materials division within Rolls-Royce. This division was one of the branches of R&D. The materials division was cut off from the rest of the firm, especially from non-technical departments.

Due to the extensive monitoring requirements of the programme, the firm needed to consolidate their accounts very frequently and input the data into TSB monitoring system. Most of these data were collected and reported by administrative divisions, mostly the accounting department. However, the TSB’s systems would require inputting accounting data together with technical data and in most of the cases these two were difficult to separate. Similarly, the pace of the administrative division, which works with large backlogs, was incompatible with the rigid requirements of the monitoring system. Therefore, the R&D department needed to learn some basic accounting to be able to input some of these data into the monitoring system. Consequently, this has created an awareness within the firm and the firm has decided that some of the accounting and project management that administrative departments used to cover can be done by the technical departments. Therefore, some of the administrative tasks were taken over by the technical departments of the firm. The government support originated a reporting routine by migration diffusion. Ostensive (understanding that they should do certain reporting), performative (reporting for monitoring) and artefact (the monitoring database) dimensions were created by the TSB support.

Consequences:

- **Learning/Stability:** This routine represents the learning about the reporting standards by non-technical departments.

- **Coordination and Control/Truce:** This routine increased the coordination between the administrative and technical departments.
9.4.4. Case B.3: Firm B.3.\textsuperscript{53}

9.4.4.1. Characteristics of the Firm

Location: This information has been excluded to anonymise the firm.

Size: Small to Medium

R&D Experience: High

Openness: Very Open

Type of Innovation: Product and Process Innovation

Technology Intensiveness: High

Sector:

- C28.1.2 - Manufacture of fluid power equipment

Interviewee(s):

This information has been excluded to anonymise the firm.

R&D Organisation: The firm is mostly R&D based.

9.4.4.2. Project B.3.

Problem: This project aimed to look at the feasibility of substituting a large low speed hydraulic pump, using seawater as hydraulic fluid to drive a Pelton Turbine generating set.

Motivation: The hope was that such a unit would be less costly, more robust and have lower environmental impact.

Research: Firm B.3. was approached by another firm, a leading firm in the development of tidal turbine. They conducted a feasibility study together, which involved extensive design and testing.

Additionality of the Project: Firm B.3. would not have conducted the project. However, their partner would have conducted it anyway.

9.4.4.2.1. Behavioural Additionality of the Project

Performance: The firm conducted all the tests required by the project leader.

Capabilities: The firm did not develop any significant capability.

Changes in the way they would have conducted the project: Without the government support, they would not have conducted the project at all.

\textsuperscript{53} The firm is anonymised at its request.
9.4.4.2.1.1. Routine B.3.1. Funding R&D

Partner firm approached the firm for a series of tests for the feasibility study of a new tidal turbine. Furthermore, the partner firm proposed to apply to TSB funding and pay for these tests from the project budget. Had there been no TSB funding, the partner firm would have paid for these tests and the activities the partner firm did would have been in the framework of an industrial consultancy.

Because the project is financed by TSB, Firm B.3. lost money. They had to pay for auditing and other reporting costs that they would not have paid otherwise. Therefore, the firm has developed a policy to avoid participating in TSB funded projects. They decided to carry on providing their services in the framework of industrial consultancy rather than TSB funding.

The firm was planning to use TSB funding for some basic research that they were planning to conduct. However, their negative experience also influenced these plans and they decided to focus on EU funding for basic research.

The TSB funding fundamentally mutated their research funding routine by changing the ostensive aspect of it.

Consequences:

- Learning/Stability: This routine led the firm to change its approach over using TSB funding and provided stability by eliminating the risk of financial loss again.
9.5. Synthesis of the Empirical Application

I have discussed a total of 14 routines in 9 firms which include 10 projects which were publicly funded by 2 different programmes, as summarised in Table 17. In this section, I will synthesise these case studies by discussing a number of patterns arising from the empirical application.

Table 17: Summary of the Empirical Application

<table>
<thead>
<tr>
<th>Programme</th>
<th>Firm</th>
<th>Project</th>
<th>Routine</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIDEB</td>
<td>Componenta Doktas</td>
<td>Crack Analysis</td>
<td>A.1.1. Testing Cracks with Ultrasound</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A.1.2. In-house R&amp;D Collaboration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thermal Process</td>
<td>A.1.3. Controlling the Temperature of Water</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A.1.4. Designing Baskets and Stacks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A.1.5. Conducting Polymer Experiments</td>
</tr>
<tr>
<td></td>
<td>Atikus</td>
<td>Carpet Knotting Machines Modernisation</td>
<td>A.2.1. Sourcing Key Components</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A.2.2. Project Planning</td>
</tr>
<tr>
<td></td>
<td>Firm A.3.</td>
<td>Multiple Projects</td>
<td>A.3.1. International R&amp;D Collaboration</td>
</tr>
<tr>
<td></td>
<td>Muradoglu</td>
<td>Microwave Tea Treatment</td>
<td>A.4.1. Manufacturing Tea</td>
</tr>
<tr>
<td></td>
<td>Ozcelik Makina</td>
<td>Multiple Projects</td>
<td>A.5.1. Conducting R&amp;D</td>
</tr>
<tr>
<td></td>
<td>CEKA</td>
<td>Slipper Machine</td>
<td>A.6.1. Using CAD Packages</td>
</tr>
</tbody>
</table>

| CR&D      | Smith & Nephew | Bioresorbable Composites | B.1.1. Controlling Storage Conditions |
|          | Rolls-Royce | Materials for Arduous Cycle and Emissions | B.2.1. Project Reporting |
|          | Firm B.3. | Project B.3. | B.3.1. Funding R&D |

The empirical application covered 2 different programmes. The former one, TIDEB programme, includes 6 different firms while the latter programme, CR&D, comprises only 3 firms as its aim is to reinforce the issues the former one left open. This is also why the former’s context conditions are discussed in more detail.

Some of the cases included multiple projects and consequently multiple routines. For instance, the Componenta Doktas case comprises 2 projects and 5 routines whereas 2 routines are discussed for Atikus. Similarly, these two cases are discussed in more detail to a degree that it almost qualifies as in-depth case studies. Some other cases do not focus on a particular project for various reasons. Rather, their boundaries are a number of projects that I do not discuss them individually. Firm A.3. is in this group as the particular projects could not be discussed due to confidentiality reasons while I analysed a particular routine overarching a number of projects.
Ozcelik Makina is in this group as well as since the main aim is to discuss an overarching issue that spans several projects funded by the programme. Finally, the rest of the cases have a one-project-to-one-routine relationship. In all of the cases, the issues I discussed are highly context sensitive and could not be unfolded as easily as possible if they did not build on a detailed discussion of the context of the programme and the firm.

The cases discussed two different types of routines: technical and management ones. Technical routines are about the production techniques and they involve a high degree of engineering background related to how the production process is organised. For instance, A1.1., in which I discuss how the routine of tackling a technical problem (cracks in pistons) is originated by the government intervention, is a good example for this. The second type of routines is related to management issues such as the routine of conducting R&D or collaborating internationally. These kind of issues have also been the subject of the conventional approach to behavioural additionality while the technical issues that I discussed in the first group have never been considered as behavioural additionality conventionally. Therefore, the empirical application illustrated that behavioural additionality is not only related to the ‘soft’ management issues. On the contrary, technical issues are also directly related with the proposed approach to behavioural additionality.

One of the two aims of this empirical application, as discussed in Chapter 7 and Section 9.1 of this chapter, is to illustrate the phases, processes and features of micro level behavioural additionality discussed in Chapter 8. Table 18 summarises the distribution of the 14 routines discussed according to these characteristics of micro behavioural additionality. The empirical application provides at least one example for each phase and process of behavioural additionality. The number of cases for MicroBA I is more than the other cases. Similarly, within MicroBA I, the processes of creation (MicroBA Ia) is illustrated by more cases than others. This endorses the discussion in Chapter 8 that as the phases and process progress, the number of routines that is subject to behavioural additionality decreases for a number of reasons. There are also cases where the routine in question spans more than one phase of micro behavioural additionality. For instance, routine A.5.1. is an illustration of both MicroBA Ia and Id as it is created by the intervention originally and diffused to the other parts of the firm.

This empirical application also shows that some routines are larger than other ones and smaller routines constitute larger routines. However, in any case the new approach to behavioural additionality can be utilised. Similarly, this chapter illustrates that some of the routines influenced by the government intervention has negative and unintended consequences (e.g. Routine A.5.1.). However, no value judgement was made as to this as the aim of the empirical application is not to conduct an evaluation but to illustrate the new approach developed.
The empirical application also illustrates how behavioural additionality is created by influencing the aspects of routines. Table 18 shows which routines involve change in ostensive, performative and artefact dimensions. It is clear from Table 18 that all the examples of behavioural additionality discussed in this case study involves an ostensive change in the routines of the firms supported. This illustrates the fact that behavioural additionality should result in a change in people’s cognitive capabilities as argued by Bach and Matt (2005). In some cases, the ostensive aspect is enough to change the routine itself and in some others, the change involved in other aspects as well. This is also related with the fact that the ostensive aspect is generally the missing link for some action to be converted into a routine and therefore potentially to become behavioural additionality. This highlights the importance of the programmes that closely interact with the target groups in which the agency maximises its impact on the cognitive capabilities of the people.

Another finding regarding the aspects of routines is that artefact aspect of the routine is not sufficient for creating behavioural additionality. All the cases that involve a change in the artefact dimension of the routines also involves another change either in the ostensive dimension alone or the ostensive and performative dimensions together. It illustrates that the physical manifestations are important but not sufficient as implied by the neoclassical framework of input-output framework in which only the tangibles are considered.

I have discussed the consequences of routines in Chapter 7 where, I summarised that routines could provide learning and stability, they can be the source of the truce and coordination and finally, they economise cognitive resources and reduce uncertainty. As summarised in Table 19, these consequences are discussed in the empirical application presented above. I observe that in all of the cases either learning / stability or economising cognitive resources / reducing uncertainty are present. There is no case where they are both absent and the only consequence of the routine is coordination and truce. This is related with the above-discussed observation about the necessity of the ostensive dimension which either brings an increase in cognitive resources or provides learning. Therefore, this reinforces the above conclusion that behavioural additionality requires a change in the ostensive dimension. It also illustrates the fact that behavioural additionality either provides learning directly or it indirectly enables learning in another area by freeing up cognitive resources that are necessary for learning.
Part II Chapter 9: An Empirical Application of the New Understanding of Behavioural Additionality

Table 18: Summary of the Illustration of the Behavioural Additionality in Cases According to the Aspects Influenced

<table>
<thead>
<tr>
<th>Phase</th>
<th>Process</th>
<th>Example</th>
<th>Aspects of Routines Influenced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ostensive Aspect</td>
</tr>
<tr>
<td>MicroBA I: Origination</td>
<td>MicroBA Ia: Creation</td>
<td>Routine A.1.1.</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Routine A.1.3.</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Routine A.1.4.</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Routine A.1.5.</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Routine A.3.1.</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Routine A.5.1.</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Routine A.6.1.</td>
<td>+</td>
</tr>
<tr>
<td>MicroBA Ib: Mutation</td>
<td></td>
<td>Routine A.2.1.</td>
<td>+</td>
</tr>
<tr>
<td>MicroBA Ic: Recombination</td>
<td></td>
<td>Routine A.4.1.</td>
<td>+</td>
</tr>
<tr>
<td>MicroBA Id: Migration / Diffusion</td>
<td></td>
<td>Routine A.5.1.</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Routine B.1.1.</td>
<td>+</td>
</tr>
<tr>
<td>MicroBA II: Adoption</td>
<td></td>
<td>Routine A.2.2.</td>
<td>+</td>
</tr>
<tr>
<td>MicroBA III: Retention / Normalisation</td>
<td></td>
<td>Routine A.1.2.</td>
<td>+</td>
</tr>
</tbody>
</table>
Table 19: Summary of the Illustration of the Behavioural Additionality in Cases According to the Consequences

<table>
<thead>
<tr>
<th>Phase</th>
<th>Process</th>
<th>Example</th>
<th>Consequences of Routines Influenced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Learning / Stability</td>
</tr>
<tr>
<td>MicroBA I:</td>
<td>MicroBA Ia:</td>
<td>Routine A.1.1.</td>
<td>+</td>
</tr>
<tr>
<td>Origination</td>
<td>Creation</td>
<td>Routine A.1.3.</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Routine A.1.4.</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Routine A.1.5.</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Routine A.3.1.</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Routine A.5.1.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Routine A.6.1.</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Routine B.1.1.</td>
<td>+</td>
</tr>
<tr>
<td>Mutation</td>
<td>Mutation</td>
<td>Routine B.3.1.</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>MicroBA Ic:</td>
<td>Routine A.4.1.</td>
<td>+</td>
</tr>
<tr>
<td>Recombination</td>
<td>MicroBA Ic:</td>
<td>Routine A.5.1.</td>
<td>+</td>
</tr>
<tr>
<td>Migration /</td>
<td>Migration /</td>
<td>Routine B.1.1.</td>
<td>+</td>
</tr>
<tr>
<td>Diffusion</td>
<td>Diffusion</td>
<td>Routine B.2.1.</td>
<td>+</td>
</tr>
<tr>
<td>MicroBA II:</td>
<td>Routine A.2.2.</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Adoption</td>
<td>Routine A.1.2.</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>MicroBA III:</td>
<td>Routine A.1.2.</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Retention /</td>
<td>Normalisation</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Normalisation</td>
<td></td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>
9.6. Conclusion

To sum up, this empirical study leads to the following main conclusions:

1. **Behavioural additionality is not only a ‘soft’ phenomenon.** The literature on behavioural additionality conceives the concept only in relation to management practices of the firm in a non-technical fashion. I have already hinted in Chapter 8 that behavioural additionality can be related to management routines as well as technical ones. This case study identified technical routines directly related to production techniques (e.g. Routine A.1.1.) and illustrated that behavioural additionality cannot be confined to ‘soft’ issues.

2. **Behavioural additionality as it is understood in this thesis can be evaluated.** This chapter illustrates that behavioural additionality, as the government influenced evolution of routines within firms, can indeed be evaluated by studying routines.

3. **The empirical model developed in this chapter is effective in identifying behavioural additionality.** The empirical model introduced in Section 9.2 and applied in Section 9.3 identifies behavioural additionality by gradually scoping it down to routines and analysing them by studying their aspects and consequences. This model proved to be an effective way of capturing behavioural additionality in Section 9.3.

4. **Behavioural additionality can be more effectively discussed by putting it into perspective.** As I have discussed in Section 9.2 of this chapter while describing the approach, this empirical application illustrates that behavioural additionality, as it is understood in the lines of the approach developed in Chapter 8, cannot be isolated from its context. The new approach puts organisational routines at the heart of behavioural additionality where organisational routines are context sensitive and path dependant. Therefore, one needs to study these context conditions to be able to frame behavioural additionality.

5. **Behavioural additionality cannot be evaluated only by employing survey based quantitative data collection methods.** It has been concluded in Chapter 3 and 8 that behavioural additionality cannot be evaluated by only using survey based data collection methods. This chapter proves that behavioural additionality needs a consideration of context conditions, which would only be possible by reinforcing possible quantitative methods with qualitative case studies that would also reveal the dynamics. Survey based methods can only shed light on the performative and artefact aspects of the routines as these aspects are less subjective. However, the ostensive aspect of the routine is highly subjective and it is not possible to provide a comparable and comprehensive account of
the ostensive dimension of routines by only using survey based methods. This is especially important considering the particular role of ostensive aspect I discuss in this chapter.
Chapter 10: Conclusion
10.1. Introduction

This chapter concludes the thesis. As the discussion has already been outlined in Chapter 8, this chapter will start with an overview of the thesis. Section 10.3 will outline the contributions of the research and finally, Section 10.4 will discuss further research areas.

10.2. Overview

As depicted in Exhibit 23, the thesis has discussed the concept of behavioural additionality in two Parts. Part I outlined the current understanding of the concept of behavioural additionality and also provided a toolset to improve the concept. As a start, I have discussed the different uses and origins of the concept of additionality in Chapter 2. The concept of additionality traces back to EU’s macro principle of additionality and it is also actively used to evaluate the projects within the Clean Development Mechanism in the context of the Kyoto Protocol. The concept of additionality is implicit in the mainstream evaluation literature akin to sociology and psychology while it is explicit and widely used in the field of evaluation allied to economic policy (particularly industrial policy). Taking its roots from the latter, behavioural additionality was originally coined as a reaction to input and output additionality, which evaluate the input and outputs created exclusively because of government intervention. The concept of behavioural additionality’s evolution has undergone three major phases, i.e. the origins, the OECD study, and the recent attempts. However, the concept is still vague and understood in four distinct ways. The fundamental reason for this problem is associated with the under-theoretisation of the concept. The current understanding of behavioural additionality criticises input-output additionality based logic because of the fact that it considers the firm as a black-box. However, the way the current understanding suggests to evaluate behavioural additionality fundamentally relies on the very same logic: by treating behaviour as a black-box and evaluating it by measuring the input and output of behaviour that are changed by the government intervention. Chapter 2 concluded that the current understanding of behavioural additionality lacks an appropriate unit of analysis.

Chapter 3 has looked at the practice of evaluation of behavioural additionality by employing a quantitative data analysis and qualitative text analysis. It has endorsed the finding that the concept needs a unit of analysis. It has also illustrated that behavioural additionality is different from other types of additionality evaluations and other evaluation topics in terms of its evaluation characteristics.

Chapter 4 looked at behavioural additionality from a different angle of innovation policy-making. It is discussed in Chapter 4 that input and output additionality are the hallmark of innovation policy a la neoclassical economic theory while behavioural additionality is the main success
criteria for an evolutionary innovation policy-making especially in Canada and France. It is revealed that behavioural additionality uses the framework of analysis of neoclassical theory, comparative statics. The conclusion of Chapter 4 was that behavioural additionality should be aligned more closely with the evolutionary approach by embracing the dynamic framework of analysis of evolutionary economics.

A conceptual framework to solve the two fundamental problems, that behavioural additionality needs a proper unit of analysis and it should adopt a new framework of analysis, is suggested in Chapter 5 and 6. Chapter 5 discussed the concept of organisational routines as a unit of analysis. It concluded that organisational routines are suitable to study both stability and change within business organisations. Chapter 6 outlined the evolutionary approach as a framework of analysis to study change and concluded that it is appropriate to explain behavioural additionality by using an evolutionary framework of analysis with organisational routines as the unit of analysis.

In summary, Part I outlined the two particular problems with the current understanding of behavioural additionality and discussed the characteristics and suitability of a particular toolset to tackle the problems identified. Therefore, it constituted the problem identification and tool building stage of the research.

Part II attempted to build a new understanding of behavioural additionality. In Chapter 7, the particulars of the research design were discussed. Chapter 8 constituted the heart of the thesis. It started with a discussion of the implicit assumptions of the current understanding of behavioural additionality and concluded that they are incompatible with various features of evolutionary economics. Deriving from this, the thesis developed a new understanding of behavioural additionality in which the evolution of organisational routines at the micro, meso and macro levels and in origination, adaption, and retention phases is the core of the concept of behavioural additionality. Furthermore, Chapter 8 included the main discussion of the thesis by reviewing the possibility, rationale and evaluation of behavioural additionality.

Chapter 9 applied a plausibility probe in which two cases of the Turkish TIDEB and British Collaborative R&D programmes were analysed to illustrate the micro level of the new understanding developed for behavioural additionality. Among other conclusions, Chapter 9 proved that the new understanding is effectively applicable.
Chapter 10: Conclusion

Conclusion: BA needs a unit of analysis

Conclusion:
- BA needs a unit of analysis
- BA is different than other evaluation topics

Conclusion:
- Evolutionary thinking is appropriate for explaining BA
- The concept of ORs are very useful for explaining both stability and change, hence a suitable candidate for the unit of analysis of BA

Conclusion: BA is an evolutionary process of change in ORs in micro, meso and macro levels. The possibility, rationale, and evaluation of BA are also outlined.

Conclusion:
- Theory explains the two cases
- An empirical model to analyse BA is devised.
10.3. Contributions

The thesis has four main contributions. Firstly, the thesis has developed a new understanding of behavioural additionality. This new understanding provides a comprehensive and consistent theoretical background for the concept. Further theoretical work on the evaluation of innovation policy and particularly behavioural additionality can utilise this understanding as a conceptual framework. Similarly, the new understanding can provide a basis for different policy discussions and it significantly reinforces the evaluability of the concept. Considering the finding in Chapter 3 that currently behavioural additionality evaluations are not perceived particularly useful and high quality by policy-makers, the new understanding would contribute towards behavioural additionality realising its true potential.

As discussed in Chapter 8, the new understanding of behavioural additionality not only addresses whether there is a case for policy-making in a complex and evolutionary economy but also sheds light to the specific role of the evolutionary policy-maker by answering the question of why and how the government should create behavioural additionality. Similarly, it has strong implications about the way behavioural additionality should be evaluated.

The new approach has the potential to support the policies that allow experimentation and variety. One of the reasons why these kinds of policies are not as common as they should be, has been the difficulty associated with their evaluation. This is particularly important in the context of the classical debate about fiscal incentives versus direct subsidies. The new approach proposed has the potential of better appreciating the policies that have close interaction with their beneficiaries.

Secondly, this thesis further contributes to the field of the evaluation of innovation policy by attempting to introduce the evolutionary approach in very concrete terms for the first time. As I have discussed in Chapters 1, 4, and 6, the field of the evaluation of innovation policy has been distinct from the wider innovation policy discussions, which are heavily influenced by the evolutionary approach. The concept of behavioural additionality has been seen as a pioneer evolutionary attempt in this field. This thesis reinforces this position by putting the evolutionary approach at the heart of behavioural additionality.

Thirdly, the thesis represents the first attempt to operationalise the concept of organisational routines in a number of different contexts. As I have extensively discussed in various ways in Chapter 5 and 8, probably the most important feature of Nelson and Winter’s (1982) work is the introduction of organisational routines to the field of innovation policy. Yet, this feature has not been fully utilised; as the concept of organisational routines, as it is understood by Nelson and Winter (1982), has never been operationalised in relation to a fundamental discussion around
innovation policy. Similarly, the concept has not been used much in the field of evaluation. This thesis represents a contribution to the literature of organisational routines in this regard.

Fourthly, the thesis has developed an empirical model to evaluate behavioural additionality. Although the aim of Chapter 9 is only to apply a plausibility probe for the micro level understanding of behavioural additionality, the empirical model developed has proved an effective tool to evaluate behavioural additionality. It also showed that it is feasible to evaluate behavioural additionality.

All in all, the thesis represented an attempt to answer the need for experimentation in the field of evaluation of innovation policy as identified by Edler and Guy (2010). Within the face of toughening economic conditions and increasing demand for understandable effects of the policy intervention, the field of innovation policy evaluation needs experimentation. The new understanding developed explores previously uncharted areas by using a known but under-used toolkit.

10.4. Further Research Areas

There are at least three different opportunities to further develop the argumentation in this thesis by further research. Firstly, as the thesis has attempted to provide an analytical look into behavioural additionality by using organisational routines and an evolutionary approach for the first time in this context, there was an unavoidable trade-off between covering all the bases and being very detailed. The thesis aimed to be comprehensive in terms of its wide coverage while in some areas some details remained unexplored. However, it has drawn the borders of a further research programme in which various features, levels, phases, and process of behavioural additionality can be further investigated.

In a similar vein, further research can focus on the issue of evaluation of behavioural additionality, as it is understood by the proposed approach. This issue has also been subject to the same trade-off and therefore remains as an area of further research, which could investigate the appropriateness of various evaluation methodologies, for instance.

Finally, as it is also outlined in Chapter 7, some of the issues have been underexplored especially in the empirical module as they need a full-scale evaluation to be illustrated. For instance, Chapter 9 only probed the plausibility of the micro level of the new understanding while meso and macro levels were left untested, as this effort would require substantial resources. However, as the new understanding is now established and the applicability of at least the micro level is illustrated, there is a clear opportunity to apply the new understanding of behavioural additionality in real life evaluations.


References


References


References


Annex I: Data Tables and Graphs for Chapter 3
Exhibit 24: Geographical Distribution

![Geographical Distribution Diagram]
### Table 20: Geographical Distribution

<table>
<thead>
<tr>
<th>Country</th>
<th>c70 Any Topic</th>
<th>c7j Input Additionality</th>
<th>c7k Output Additionality</th>
<th>c7l Behavioural Additionality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>AT</td>
<td>100%</td>
<td>27%</td>
<td>73%</td>
<td>73%</td>
</tr>
<tr>
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<td>20%</td>
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<td>32%</td>
</tr>
<tr>
<td>BE</td>
<td>100%</td>
<td>50%</td>
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Legend:
- Whole Dataset
- Input Additionality Subset
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### Annex 1: Data Tables and Graphs for Chapter 3

#### Exhibit 26: Structural Funds and Portfolio Evaluations

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#### Exhibit 26: Structural Funds and Portfolio Evaluations

- **Whole Dataset**: Structural Fund Evaluation and Portfolio Evaluation.
- **Behavioural Additionality Subset**: Structural Fund Evaluation and Portfolio Evaluation.
- **Output Additionality Subset**: Structural Fund Evaluation and Portfolio Evaluation.
- **Input Additionality Subset**: Structural Fund Evaluation and Portfolio Evaluation.
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<th>56%</th>
<th>44%</th>
<th>56%</th>
<th>44%</th>
<th>33%</th>
<th>67%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Column N %</td>
<td>22%</td>
<td>24%</td>
<td>19%</td>
<td>25%</td>
<td>20%</td>
<td>14%</td>
<td>27%</td>
<td></td>
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</tr>
<tr>
<td>Pearson Chi-Square</td>
<td>0.64</td>
<td>0.61</td>
<td></td>
<td>4.36</td>
<td></td>
<td></td>
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<tr>
<td>Pearson Correlation</td>
<td>0.07</td>
<td>0.06</td>
<td></td>
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</tr>
<tr>
<td>Significance (two-tailed)</td>
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<td>0.44</td>
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</tbody>
</table>

Exhibit 27: Types of Evaluators
Annex 1: Data Tables and Graphs for Chapter 3

Table 23: Types of Evaluators

<table>
<thead>
<tr>
<th>c1a Who conducted the appraisal?</th>
<th>c70 Any Topic</th>
<th>c7j Input Additionality</th>
<th>c7k Output Additionality</th>
<th>c7l Behavioural Additionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>internal</td>
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<td>65%</td>
<td>35%</td>
</tr>
<tr>
<td>Column N %</td>
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<td>12%</td>
<td>18%</td>
<td>10%</td>
</tr>
<tr>
<td>external</td>
<td>Row N %</td>
<td>100%</td>
<td>43%</td>
<td>57%</td>
</tr>
<tr>
<td>Column N %</td>
<td></td>
<td>77%</td>
<td>67%</td>
<td>88%</td>
</tr>
<tr>
<td>mixed</td>
<td>Row N %</td>
<td>100%</td>
<td>85%</td>
<td>15%</td>
</tr>
<tr>
<td>Column N %</td>
<td></td>
<td>11%</td>
<td>15%</td>
<td>3%</td>
</tr>
<tr>
<td>Pearson Chi-Square</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significance (two-tailed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Exhibit 28: Tender Process

- Whole Dataset
  - Input Additionality Subset: 15% internal, 19% No tender, 19% closed, 45% open, 45% other
  - Output Additionality Subset: 13% internal, 16% No tender, 21% closed, 48% open, 48% other
  - Behavioural Additionality Subset: 27% internal, 15% No tender, 13% closed, 45% open, 45% other
  - Input Additionality Subset: 27% internal, 14% No tender, 18% closed, 41% open, 41% other
Table 24: Tender Process

<table>
<thead>
<tr>
<th>Tender Procedure</th>
<th>c70 Any Topic</th>
<th>c7j Input Additionality</th>
<th>c7k Output Additionality</th>
<th>c7l Behavioural Additionality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
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<tr>
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<td>6%</td>
<td>94%</td>
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<td>2%</td>
<td>27%</td>
</tr>
<tr>
<td>Column N %</td>
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<td>64%</td>
<td>43%</td>
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<td>19%</td>
<td>14%</td>
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<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Significance (two-tailed)</td>
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<td>0.63</td>
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</table>

Exhibit 29: Timing of Evaluations

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<th>40%</th>
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<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>100%</th>
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</thead>
<tbody>
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<td>Input Additionality Subset</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Output Additionality Subset</td>
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<td>33%</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behavioural Additionality Subset</td>
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<td>18%</td>
<td>39%</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

- ex-ante
- accompanying
- interim
- ex-post
- other
### Table 25: Timing of Evaluations

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<thead>
<tr>
<th>Timing of the appraisal</th>
<th>c70 Any Topic</th>
<th>c7j Input Additionality</th>
<th>c7k Output Additionality</th>
<th>c7l Behavioural Additionality</th>
</tr>
</thead>
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<td></td>
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<td>33%</td>
<td>67%</td>
<td>33%</td>
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<td></td>
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<td>Row N %</td>
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<td>45%</td>
<td>70%</td>
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<td>19%</td>
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<tr>
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<td>33%</td>
</tr>
<tr>
<td>ex-post</td>
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<td>Row N %</td>
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<td>Row N %</td>
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<td>33%</td>
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<td>3%</td>
<td>1%</td>
<td>3%</td>
</tr>
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<td>Pearson Chi-Square</td>
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<td>Pearson Correlation</td>
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<td>0.20</td>
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</tr>
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<td>0.01</td>
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### Exhibit 30: Purpose of Evaluations

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<th>20%</th>
<th>30%</th>
<th>40%</th>
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<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Additionality Subset</td>
<td>21%</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Additionality Subset</td>
<td>27%</td>
<td>27%</td>
<td>38%</td>
<td>8%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behavioural Additionality Subset</td>
<td>22%</td>
<td>29%</td>
<td>41%</td>
<td>8%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tbody>
</table>

- Summative
- Formative
- Both
- Other
### Table 26: Purpose of Evaluations

<table>
<thead>
<tr>
<th>Purpose of the Appraisal</th>
<th>c70 Any Topic</th>
<th>c7j Input Additionality</th>
<th>c7k Output Additionality</th>
<th>c7l Behavioural Additionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summative (judgemental)</td>
<td>Row N %</td>
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<td>58%</td>
<td>42%</td>
</tr>
<tr>
<td></td>
<td>Column N %</td>
<td>21%</td>
<td>27%</td>
<td>19%</td>
</tr>
<tr>
<td>Formative (supporting)</td>
<td>Row N %</td>
<td>100%</td>
<td>29%</td>
<td>71%</td>
</tr>
<tr>
<td></td>
<td>Column N %</td>
<td>41%</td>
<td>27%</td>
<td>62%</td>
</tr>
<tr>
<td>both</td>
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<td>69%</td>
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<tr>
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</tr>
<tr>
<td></td>
<td>Column N %</td>
<td>5%</td>
<td>8%</td>
<td>3%</td>
</tr>
</tbody>
</table>

Pearson Chi-Square: 19.69, 17.89, 15.50
Pearson Correlation: 0.15, 0.21, 0.18
Significance (two-tailed): 0.07, 0.01, 0.03

### Exhibit 31: Evaluation Budget

- **Whole Dataset**: 46%
- **Input Additionality Subset**: 41%
- **Output Additionality Subset**: 44%
- **Behavioural Additionality Subset**: 40%
Table 27: Evaluation Budget

<table>
<thead>
<tr>
<th>c5a Does the policy measure have a dedicated budget for appraisal?</th>
<th>c70 Any Topic</th>
<th>c7j Input Additionality</th>
<th>c7k Output Additionality</th>
<th>c7l Behavioural Additionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Row N %</td>
<td>100%</td>
<td>45%</td>
<td>55%</td>
<td>49%</td>
</tr>
<tr>
<td>Column N %</td>
<td>46%</td>
<td>41%</td>
<td>43%</td>
<td>44%</td>
</tr>
<tr>
<td>Pearson Chi-Square</td>
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<td>0.10</td>
<td>1.22</td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>-0.02</td>
<td>0.03</td>
<td>-0.11</td>
<td></td>
</tr>
<tr>
<td>Significance (two-tailed)</td>
<td>0.83</td>
<td>0.75</td>
<td>0.27</td>
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</tr>
</tbody>
</table>

Exhibit 32: Planned Evaluation

![Bar chart showing distribution of planned evaluations for different subsets]

Table 28: Planned Evaluation

<table>
<thead>
<tr>
<th>c6a Was the appraisal, to which this template refers, foreseen and planned for during the design phase of the measure?</th>
<th>c70 Any Topic</th>
<th>c7j Input Additionality</th>
<th>c7k Output Additionality</th>
<th>c7l Behavioural Additionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Row N %</td>
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<tr>
<td>Column N %</td>
<td>67%</td>
<td>69%</td>
<td>70%</td>
<td>72%</td>
</tr>
<tr>
<td>Pearson Chi-Square</td>
<td>0.03</td>
<td>0.77</td>
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<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>-0.01</td>
<td>0.07</td>
<td>0.12</td>
<td></td>
</tr>
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<td>Significance (two-tailed)</td>
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<td>0.14</td>
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</table>
Exhibit 33: Impacts Looked at in Evaluations

<table>
<thead>
<tr>
<th></th>
<th>Scientific Impact</th>
<th>Technological Impact</th>
<th>Economic Impact</th>
<th>Social Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Dataset</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Additionality Subset</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Additionality Subset</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behavioural Additionality Subset</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

% of Whole Dataset
- Scientific Impact: 43%
- Technological Impact: 59%
- Economic Impact: 63%
- Social Impact: 49%

% of Input Additionality Subset
- Scientific Impact: 28%
- Technological Impact: 59%
- Economic Impact: 63%
- Social Impact: 49%

% of Output Additionality Subset
- Scientific Impact: 34%
- Technological Impact: 47%
- Economic Impact: 40%
- Social Impact: 49%

% of Behavioural Additionality Subset
- Scientific Impact: 25%
- Technological Impact: 43%
- Economic Impact: 49%
- Social Impact: 72%
Table 29: Impacts Looked at in Evaluations

<table>
<thead>
<tr>
<th></th>
<th>c70 Any Topic</th>
<th>c7j Input Additionality</th>
<th>c7k Output Additionality</th>
<th>c7l Behavioural Additionality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>c8a Scientific</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, on the participants and beyond</td>
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<td>74%</td>
<td>26%</td>
<td>78%</td>
</tr>
<tr>
<td>Column N %</td>
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<td>33%</td>
<td>11%</td>
<td>36%</td>
</tr>
<tr>
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<td>83%</td>
</tr>
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<td>7%</td>
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<tr>
<td>No</td>
<td>100%</td>
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<td>67%</td>
<td>30%</td>
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<td>41%</td>
<td>82%</td>
<td>37%</td>
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<td>72%</td>
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<td>0.57</td>
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## Annex 1: Data Tables and Graphs for Chapter 3

### Exhibit 34: Evaluation Sponsors

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### Exhibit 34: Evaluation Sponsors

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- **Other Government Department**: 20%, 19%, 22%, 23%
- **Other Public Bodies**: 10%, 5%, 5%, 6%
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**Exhibit 37: Data Analysis Methods**

- **c12d Descriptive Statistics**
- **c12g Context Analysis**
- **c12f Document Analysis**
- **c12a Case Study Analysis**
- **c12e Input/Output Analysis**
- **c12c Econometric Analysis**
- **c12b Network Analysis**

- Whole Dataset
- Input Additionality Subset
- Output Additionality Subset
- Behavioural Additionality Subset
### Table 33: Data Analysis Methods

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Exhibit 38: Main Intended Audiences of Evaluation

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### Table 34: Main Intended Audiences of Evaluation

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<td>28%</td>
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<tr>
<td>Pearson Chi-Square</td>
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<td>4.65</td>
<td>8.33</td>
<td>3.37</td>
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<tr>
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<td>0.26</td>
<td>0.17</td>
</tr>
<tr>
<td>Significance (two-tailed)</td>
<td></td>
<td>0.03</td>
<td>0.00</td>
<td>0.07</td>
</tr>
</tbody>
</table>

---

Annex 1: Data Tables and Graphs for Chapter 3
### Annex 1: Data Tables and Graphs for Chapter 3

#### c14h Policy Analysts

<table>
<thead>
<tr>
<th></th>
<th>c70 Any Topic</th>
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<th>c7k Output Additionality</th>
<th>c7l Behavioural Additionality</th>
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<td>No</td>
<td>Yes</td>
<td>No</td>
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#### c14i General Public

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<td>Yes</td>
<td>No</td>
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<td>35%</td>
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</tr>
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<td>Significance (two-tailed)</td>
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### Exhibit 39: Terms of References of Evaluations

<table>
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<th>Terms of References</th>
<th>Whole Dataset</th>
<th>Input Additionality Subset</th>
<th>Output Additionality Subset</th>
<th>Behavioural Additionality Subset</th>
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<tr>
<td>ToR available in the report</td>
<td>40%</td>
<td>49%</td>
<td>49%</td>
<td>50%</td>
</tr>
<tr>
<td>ToR available elsewhere?</td>
<td>56%</td>
<td>54%</td>
<td>55%</td>
<td>61%</td>
</tr>
<tr>
<td>ToR clearly states the objective of the appraisal?</td>
<td>94%</td>
<td>89%</td>
<td>90%</td>
<td>91%</td>
</tr>
<tr>
<td>Methodologies and approaches specified in the ToR</td>
<td>36%</td>
<td>37%</td>
<td>31%</td>
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### Table 35: Terms of References of Evaluations

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<th>c7k Output Additionality</th>
<th>c7l Behavioural Additionality</th>
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</thead>
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<td></td>
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<td>Yes</td>
<td>No</td>
<td>Yes</td>
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<td>27%</td>
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<td>0.00</td>
</tr>
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<td>43%</td>
</tr>
<tr>
<td></td>
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<td>54%</td>
<td>56%</td>
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<td>0.00</td>
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<td></td>
<td>Pearson Correlation</td>
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<td></td>
<td>Significance (two-tailed)</td>
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<td>0.98</td>
<td>0.31</td>
</tr>
<tr>
<td>d1c If the Terms of Reference were available, did they clearly state the objective of the appraisal?</td>
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<td>Row N %</td>
<td>100%</td>
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</tr>
<tr>
<td></td>
<td>Column N %</td>
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<td>89%</td>
<td>97%</td>
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<td>Pearson Correlation</td>
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<td>0.26</td>
<td>0.42</td>
</tr>
<tr>
<td></td>
<td>Significance (two-tailed)</td>
<td>0.18</td>
<td>0.26</td>
<td>0.42</td>
</tr>
<tr>
<td>d2b Were methodologies and approaches specified in the Terms of Reference?</td>
<td>Yes</td>
<td>Row N %</td>
<td>100%</td>
<td>53%</td>
</tr>
<tr>
<td></td>
<td>Column N %</td>
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<td>27%</td>
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<td></td>
<td>Pearson Chi-Square</td>
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<td>Pearson Correlation</td>
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<td>0.03</td>
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<tr>
<td></td>
<td>Significance (two-tailed)</td>
<td>0.65</td>
<td>0.80</td>
<td>0.31</td>
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</tbody>
</table>
Exhibit 40: Perceived Quality of Evaluations

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<th>Output Additionality Subset</th>
<th>Behavioural Additionality Subset</th>
</tr>
</thead>
<tbody>
<tr>
<td>d1d If Terms of Reference are given, does the appraisal address them?</td>
<td>4.26</td>
<td>4.22</td>
<td>4.28</td>
<td>4.31</td>
</tr>
<tr>
<td>d3a Was/Is the design of the evaluation appropriate given the objectives</td>
<td>4.10</td>
<td>4.27</td>
<td>4.11</td>
<td>4.12</td>
</tr>
<tr>
<td>of the evaluation and the nature of the policy measure?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d4a Did/Do the methods chosen satisfy the Terms of Reference/purpose of</td>
<td>4.32</td>
<td>4.40</td>
<td>4.29</td>
<td>4.32</td>
</tr>
<tr>
<td>the appraisal?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d5a Was/Is the application of the qualitative methods satisfactory?</td>
<td>3.97</td>
<td>4.20</td>
<td>4.02</td>
<td>4.18</td>
</tr>
<tr>
<td>d6a Was/Is the application of the quantitative methods satisfactory?</td>
<td>3.86</td>
<td>4.21</td>
<td>3.98</td>
<td>4.00</td>
</tr>
<tr>
<td>d7a Were/Are the information sources used in the report well documented</td>
<td>4.14</td>
<td>4.24</td>
<td>3.98</td>
<td>4.15</td>
</tr>
<tr>
<td>and referenced?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d8a Was/Is the analysis clearly based on the data given?</td>
<td>4.29</td>
<td>4.49</td>
<td>4.38</td>
<td>4.41</td>
</tr>
<tr>
<td>d9a Given the objectives of the appraisal, does the analysis cover the</td>
<td>3.50</td>
<td>3.71</td>
<td>3.57</td>
<td>3.53</td>
</tr>
<tr>
<td>broader context (e.g. societal, institutional, policy and economic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>contexts) sufficiently?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e1a Were/Are the conclusions based on the analysis?</td>
<td>4.35</td>
<td>4.74</td>
<td>4.55</td>
<td>4.68</td>
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</tbody>
</table>

Note: Scale is 5 point Likert. "1" was given as "No, not at all", "5" as "Yes, definitely" and intermediate values were not defined.
### Table 36: Perceived Quality of Evaluations

<table>
<thead>
<tr>
<th>d1d If Terms of Reference are given, does the appraisal address them?</th>
<th>c70 Any Topic</th>
<th>c7j Input Additionality</th>
<th>c7k Output Additionality</th>
<th>c7l Behavioural Additionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>4.26</td>
<td>4.22</td>
<td>4.14</td>
<td>4.28</td>
</tr>
<tr>
<td>Sperman Correlation</td>
<td>0.05</td>
<td>0.03</td>
<td>0.12</td>
<td>0.65</td>
</tr>
<tr>
<td>Significance (two-tailed)</td>
<td>0.65</td>
<td>0.80</td>
<td>0.31</td>
<td></td>
</tr>
</tbody>
</table>

| d3a Was/Is the design of the evaluation approp. given the objectives of the evaluation and the nature of the policy measure? | Mean | 4.10 | 4.27 | 3.90 | 4.11 | 4.00 | 4.12 | 4.02 |
| Sperman Correlation | 0.26 | 0.08 | 0.08 |
| Significance (two-tailed) | 0.01 | 0.43 | 0.39 |

| d4a Did/Do the methods chosen satisfy the ToR / purpose of the appraisal? | Mean | 4.32 | 4.40 | 4.14 | 4.29 | 4.26 | 4.32 | 4.23 |
| Sperman Correlation | 0.22 | 0.04 | 0.02 |
| Significance (two-tailed) | 0.05 | 0.70 | 0.84 |

| d5a Was/Is the application of the qualitative methods satisfactory? | Mean | 3.97 | 4.20 | 3.70 | 4.02 | 3.79 | 4.18 | 3.67 |
| Sperman Correlation | 0.29 | 0.13 | 0.28 |
| Significance (two-tailed) | 0.00 | 0.19 | 0.00 |

| d6a Was/Is the application of the quantitative methods satisfactory? | Mean | 3.86 | 4.21 | 3.58 | 3.98 | 3.71 | 4.00 | 3.69 |
| Sperman Correlation | 0.37 | 0.18 | 0.19 |
| Significance (two-tailed) | 0.00 | 0.08 | 0.06 |

| d7a Were/Are the information sources used in the report well documented and referenced? | Mean | 4.14 | 4.24 | 4.07 | 3.98 | 4.21 | 4.15 | 4.15 |
| Sperman Correlation | 0.03 | -0.13 | -0.02 |
| Significance (two-tailed) | 0.72 | 0.18 | 0.81 |

| d8a Was/Is the analysis clearly based on the data given? | Mean | 4.29 | 4.49 | 4.05 | 4.38 | 4.13 | 4.41 | 4.13 |
| Sperman Correlation | 0.33 | 0.20 | 0.21 |
| Significance (two-tailed) | 0.00 | 0.04 | 0.02 |

| d9a Given the objectives of the appraisal, does the analysis cover the broader context (e.g. societal, institutional, policy and economic) sufficiently? | Mean | 3.50 | 3.71 | 3.23 | 3.57 | 3.25 | 3.53 | 3.38 |
| Sperman Correlation | 0.20 | 0.13 | 0.05 |
| Significance (two-tailed) | 0.03 | 0.18 | 0.59 |

| e1a Were/Are the conclusions based on the analysis? | Mean | 4.35 | 4.74 | 4.02 | 4.55 | 4.11 | 4.68 | 3.96 |
| Sperman Correlation | 0.42 | 0.23 | 0.39 |
| Significance (two-tailed) | 0.00 | 0.01 | 0.00 |
Exhibit 41: Perceived Usefulness of Recommendations

Note: Scale is 5 point Likert. "1" was given as "No, not at all", "5" as "Yes, definitely" and intermediate values were not defined.
### Table 37: Perceived Usefulness of Recommendations

<table>
<thead>
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<th>c70 Any Topic</th>
<th>c7j Input Additionality</th>
<th>c7k Output Additionality</th>
<th>c7l Behavioural Additionality</th>
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</thead>
<tbody>
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<td>Mean</td>
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<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
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<td>2.87</td>
<td>3.20</td>
<td>2.92</td>
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<td>Sperman Correlation</td>
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<td>-0.10</td>
<td>-0.08</td>
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<tr>
<td>Significance (two-tailed)</td>
<td>0.29</td>
<td>0.41</td>
<td>0.47</td>
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</table>

<table>
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<th>Mean</th>
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<th>Yes</th>
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<th>Yes</th>
<th>No</th>
<th>Yes</th>
<th>No</th>
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<td>3.08</td>
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<td>Sperman Correlation</td>
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<td>-0.16</td>
<td>-0.11</td>
<td>0.03</td>
<td>0.17</td>
<td>0.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significance (two-tailed)</td>
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<td>0.17</td>
<td>0.06</td>
<td>0.64</td>
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<td>0.60</td>
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<table>
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<th>Mean</th>
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<th>Yes</th>
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<th>Yes</th>
<th>No</th>
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<th>No</th>
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<td>-0.04</td>
<td>0.06</td>
<td>0.64</td>
<td>0.72</td>
<td>0.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significance (two-tailed)</td>
<td>0.64</td>
<td>0.72</td>
<td>0.60</td>
<td>0.73</td>
<td>0.82</td>
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</table>

<table>
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<th>Yes</th>
<th>No</th>
<th>Yes</th>
<th>No</th>
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<td>2.14</td>
<td>2.00</td>
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<td>1.79</td>
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<tr>
<td>Sperman Correlation</td>
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<td>0.03</td>
<td>0.17</td>
<td>0.73</td>
<td>0.82</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Significance (two-tailed)</td>
<td>0.73</td>
<td>0.82</td>
<td>0.21</td>
<td>0.65</td>
<td>0.41</td>
<td>0.54</td>
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</table>

<table>
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<th>Yes</th>
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<th>Yes</th>
<th>No</th>
<th>Yes</th>
<th>No</th>
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<td>2.80</td>
<td>3.00</td>
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<td>2.78</td>
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<tr>
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<td>-0.10</td>
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Exhibit 42: Discussion of the Results

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<th>5.00</th>
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<tbody>
<tr>
<td>f1a Were/Are the analysis and recommendations of the appraisal widely discussed within government circles?</td>
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</tr>
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<td>3.44</td>
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<tr>
<td>Output Additionality Subset</td>
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<td>3.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behavioural Additionality Subset</td>
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<td>3.62</td>
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<td></td>
</tr>
<tr>
<td>f2a Were/Are the analysis and recommendations of the appraisal widely discussed with participants and broader stakeholders?</td>
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</tr>
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<td>3.31</td>
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<td>3.58</td>
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</tr>
<tr>
<td>Output Additionality Subset</td>
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</tr>
<tr>
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<td>3.58</td>
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<td></td>
</tr>
</tbody>
</table>

Note: Scale is 5 point Likert. "1" was given as "No, not at all", "5" as "Yes, definitely" and intermediate values were not defined.

Table 38: Discussion of the Results

<table>
<thead>
<tr>
<th></th>
<th>c70 Any Topic</th>
<th>c7j Input Additionality</th>
<th>c7k Output Additionality</th>
<th>c7l Behavioural Additionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>f1a Were/Are the analysis and recommendations of the appraisal widely discussed within government circles?</td>
<td>Mean</td>
<td>3.37</td>
<td>3.68</td>
<td>3.31</td>
</tr>
<tr>
<td>Sperman Correlation</td>
<td>0.16</td>
<td>0.02</td>
<td>0.16</td>
<td></td>
</tr>
<tr>
<td>Significance (two-tailed)</td>
<td>0.13</td>
<td>0.84</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>f2a Were/Are the analysis and recommendations of the appraisal widely discussed with participants and broader stakeholders?</td>
<td>Mean</td>
<td>3.35</td>
<td>3.39</td>
<td>3.31</td>
</tr>
<tr>
<td>Sperman Correlation</td>
<td>0.03</td>
<td>0.02</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td>Significance (two-tailed)</td>
<td>0.78</td>
<td>0.88</td>
<td>0.09</td>
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</tr>
</tbody>
</table>
**Exhibit 43: Consequences of Evaluations**

<table>
<thead>
<tr>
<th>Measure Description</th>
<th>Whole Dataset</th>
<th>Input Additionality Subset</th>
<th>Output Additionality Subset</th>
<th>Behavioural Additionality Subset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Termination of the measure</td>
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<td>3%</td>
<td>3%</td>
<td>5%</td>
</tr>
<tr>
<td>Major re-design of the measure</td>
<td>12%</td>
<td>10%</td>
<td>10%</td>
<td>12%</td>
</tr>
<tr>
<td>Minor re-design of the measure</td>
<td>35%</td>
<td>43%</td>
<td>44%</td>
<td>35%</td>
</tr>
<tr>
<td>Expansion/Prolongation</td>
<td>37%</td>
<td>46%</td>
<td>45%</td>
<td>37%</td>
</tr>
<tr>
<td>Re-design of another measure</td>
<td>7%</td>
<td>19%</td>
<td>21%</td>
<td>7%</td>
</tr>
<tr>
<td>Merger of measures</td>
<td>13%</td>
<td>12%</td>
<td>16%</td>
<td>13%</td>
</tr>
</tbody>
</table>

Legend:
- Whole Dataset
- Input Additionality Subset
- Output Additionality Subset
- Behavioural Additionality Subset
Table 39: Consequences of Evaluations

<table>
<thead>
<tr>
<th></th>
<th>Any Topic</th>
<th>Input Additionality</th>
<th>Output Additionality</th>
<th>Behavioural Additionality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td><strong>f3at Termination of the measure</strong></td>
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<td>75%</td>
<td>25%</td>
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<tr>
<td></td>
<td>Column N %</td>
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<td>2%</td>
</tr>
<tr>
<td></td>
<td>Pearson Chi-Square</td>
<td>1.52</td>
<td>1.11</td>
<td>1.11</td>
</tr>
<tr>
<td></td>
<td>Pearson Correlation</td>
<td>0.11</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>Significance (two-tailed)</td>
<td>0.22</td>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td><strong>f3bt Major re-design of the measure</strong></td>
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<td>100%</td>
<td>75%</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>Column N %</td>
<td>8%</td>
<td>12%</td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td>Pearson Chi-Square</td>
<td>3.16</td>
<td>1.20</td>
<td>1.20</td>
</tr>
<tr>
<td></td>
<td>Pearson Correlation</td>
<td>0.17</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>Significance (two-tailed)</td>
<td>0.08</td>
<td>0.28</td>
<td>0.28</td>
</tr>
<tr>
<td><strong>f3ct Minor re-design of the measure</strong></td>
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<td>100%</td>
<td>32%</td>
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</tr>
<tr>
<td></td>
<td>Column N %</td>
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<td>61%</td>
</tr>
<tr>
<td></td>
<td>Pearson Chi-Square</td>
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<td>0.87</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td>Pearson Correlation</td>
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<td>-0.09</td>
<td>-0.09</td>
</tr>
<tr>
<td></td>
<td>Significance (two-tailed)</td>
<td>0.00</td>
<td>0.36</td>
<td>0.36</td>
</tr>
<tr>
<td><strong>f3dt Expansion/Prolongation</strong></td>
<td>Yes</td>
<td>100%</td>
<td>55%</td>
<td>45%</td>
</tr>
<tr>
<td></td>
<td>Column N %</td>
<td>37%</td>
<td>46%</td>
<td>31%</td>
</tr>
<tr>
<td></td>
<td>Pearson Chi-Square</td>
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<td>2.77</td>
<td>2.77</td>
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<td></td>
<td>Pearson Correlation</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>Significance (two-tailed)</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td><strong>f3et Re-design of aNother measure</strong></td>
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<td>100%</td>
<td>67%</td>
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</tr>
<tr>
<td></td>
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<td>17%</td>
<td>19%</td>
<td>8%</td>
</tr>
<tr>
<td></td>
<td>Pearson Chi-Square</td>
<td>3.32</td>
<td>3.65</td>
<td>3.65</td>
</tr>
<tr>
<td></td>
<td>Pearson Correlation</td>
<td>0.17</td>
<td>0.18</td>
<td>0.18</td>
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<tr>
<td></td>
<td>Significance (two-tailed)</td>
<td>0.07</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td><strong>f3ft Merger of measures</strong></td>
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<td>100%</td>
<td>54%</td>
<td>46%</td>
</tr>
<tr>
<td></td>
<td>Column N %</td>
<td>11%</td>
<td>13%</td>
<td>9%</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Pearson Correlation</td>
<td>0.06</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>Significance (two-tailed)</td>
<td>0.49</td>
<td>0.95</td>
<td>0.95</td>
</tr>
</tbody>
</table>
Interview Strategy

- Performance
  - Intended
  - Unintended

- Capabilities

- Activities
  - Rules and Standard Operating Procedures (R&OP)
  - Dispositions (D)

- Recurrent Interaction Patterns (RIP)

- Changes in Routines
  - Variation
  - Selection
  - Retention
Interview Guide

Section I: Performance

This section will mainly be dealt in the interviews with top-level management and/or R&D management of the firm. The main aim of this section is to form the context and to provide narrowing down.

Additionality will be a dimension that is sought for both by direct and indirect questions imposing hypothetical conditions and additional barriers.

Typical Questions will be as following:

- What have you achieved with that project? Have you realised any concrete benefits (such as an increase in the efficiency or a decrease in the cost)?
- Have you realised any difference in other areas?
- Additionality Questions:
  - Would you conduct this project if you were not supported?
    - If yes (or yes but in smaller scale or faster or in different fashion, etc.), would you realise any of the above benefits anyway?
    - If yes, would these benefits be as persistent as it is now?
    - If no, why?
  - Would you conduct this project if the support were half of what you got for instance?
    - If yes (or yes but in smaller scale or faster or in different fashion, etc.), would you realise any of the above benefits anyway?
    - If yes, would these benefits be as persistent as it is now?
    - If no, why?

Section II: Capabilities

This section will narrow down to the capabilities that the firm developed to achieve the above stated performances.

Again, additionality question in various direct and indirect forms will be asked.

Typical Questions:

- How have you achieved these performances? What kind of capabilities have you developed? What are the causes of this performance?
- Could you develop these capabilities if you did not conduct this project?
  - If yes, would there be any difference in the pace, magnitude, etc.?
  - If yes, these capabilities be more persistent than it is now?
  - If no, why?
- Could you develop these capabilities if you were not supported by the programme?
  - If yes, would there be any difference in the pace, magnitude, etc.?
  - If yes, these capabilities be more persistent than it is now?
Section III: Activities

This section will try to explore the activities undertaken to realise the performances and to develop capabilities.

This section will be closely linked with the Capabilities section and the sequence will be changed if needed?

Typical Questions:

- What kind of activities have you performed to be able to realise these performances? What do you do?
- Would you perform them if you did not conduct this project?
  - If yes, would there be any difference in the pace, magnitude, etc.?
  - If yes, would it be more persistent?
  - If no, why?
- Would you perform them if you were not supported by the programme?
  - If yes, would there be any difference in the pace, magnitude, etc.?
  - If yes, would it be more persistent?
  - If no, why?
- What if the support were less than what you got, half of it for instance? Would you perform these activities

Section IV: Recurrent Interaction Patterns

This section will try to zoom in a deeper level than capabilities/activities. This section will be particularly discussed with the people who conduct activities (i.e. engineers or technicians rather than managers or supervisors).

R&SOP and Dispositions will be asked as well to differentiate them from routines.

Sequential variety, Frequency and stability of these routines will be sought.

Finally, for each change in routines the contribution of this change to the outcome of routine will be investigated.

Similar to other parts additionality questions will follow other questions:

Typical Questions for the undertaker of tasks (engineers, technicians etc):

- What kind of tasks do you do to accomplish these activities? How did you do them?
  - Do you think the other people do these tasks more or less in the same way you follow?
(Sequential Variety) Do you do these tasks more or less in the same way every time?
(Frequency) How often do you do these tasks?
Have anything changed in these tasks because of that project?
  - If yes, would that be the case if you were not supported by the programme?
  - If yes, would it be more persistent?
  - If no, why?
Would these changes have happened if the support was half?

R&SOP:
Are there any fixed rules or standard operating procedures for you to follow these tasks?
Do you think the other people follow these rules more or less in the same way you follow?
Have anything changed in these rules and standard operating procedures because of that project?
  - If yes, would that be the case if you were not supported by the programme?
  - If yes, would it be more persistent?
  - If no, why?
Would these changes have happened if the support was half?

Dispositions (in personal level) (this discourse will be linked to corporate culture):
Do you have any certain way of doing this task?
Do you think other people do this task as you do?
Have anything changed in your way of doing things because of that project?
  - If yes, would that be the case if you were not supported by the programme?
  - If yes, would it be more persistent?
  - If no, why?
Would these changes have happened if the support was half?

Do you think these changes?
(Coordination and Control/Truce) Provided you more coordination
  - Would it be the case if you did not conduct the project
  - Would it be the case if you were not supported by the programme?
  - How persistent would it be?
  - Would it be the case if the conditions were different, for instance if the support was half?
(Economising Cognitive Resources/Reducing Uncertainty) Save your time devise a new way
  - Would it be the case if you did not conduct the project
  - Would it be the case if you were not supported by the programme?
  - How persistent would it be?
  - Would it be the case if the conditions were different, for instance if the support was half?
(Learning/Stability) Taught you an efficient and stable way
  - Would it be the case if you did not conduct the project
  - Would it be the case if you were not supported by the programme?)
- How persistent would it be?
  - Would it be the case if the conditions were different, for instance if the support was half?

- **VSR**
  - **Retention:**
    - Do you happen to know, because you conducted this project anything has changed in the other parts of the firm?
    - Do you happen to know, because you conducted this project anything has changed in the other firms you work with?
  - **Variation:**
    - For the changes (attributable to the intervention) in the way of doing things, what were the reasons?
      - Because programme imposed some best practices?
      - Because you had to comply with reporting rules?
      - Because you had to comply with the other rules of the programme?
  - **Selection:** (by introducing an example)
    - Did you selected these routines instead of other ones to conduct the activity/capability because you are supported by the programme?

**Typical Questions for the overseer of tasks (R&D Managers, production managers, etc):**

- **Do you think these changes?**
  - **(Coordination and Control/Truce)** Provided the undertakers of the tasks more coordination
    - Would it be the case if you did not conduct the project
    - Would it be the case if you were not supported by the programme?
    - How persistent would it be?
    - Would it be the case if the conditions were different, for instance if the support was half?
  - **(Economising Cognitive Resources/Reducing Uncertainty)** Save the undertakers of the tasks time to devise a new way
    - Would it be the case if you did not conduct the project
    - Would it be the case if you were not supported by the programme?
    - How persistent would it be?
    - Would it be the case if the conditions were different, for instance if the support was half?
  - **(Learning/Stability)** Taught the undertakers of the tasks an efficient and stable way
    - Would it be the case if you did not conduct the project
    - Would it be the case if you were not supported by the programme?
    - How persistent would it be?
    - Would it be the case if the conditions were different, for instance if the support was half?
  - **(Storing Knowledge)** made the undertakers of the tasks better integrate the know-how gained from the project to the firm
Annex 2: Preliminary Case Study Methodology and Interview Guide Document for Chapter 7

- Would it be the case if you did not conduct the project?
- Would it be the case if you were not supported by the programme?
- How persistent would it be?

- VSR
  - Retention:
    - Do you happen to know, because you conducted this project anything has changed in the other parts of the firm?
    - Do you happen to know, because you conducted this project anything has changed in the other firms you work with?
  - Variation:
    - For the changes (attributable to the intervention) in the way of doing things explained by the undertaker of this task, what were the reasons?
      - Because programme imposed some best practices?
      - Because you had to comply with reporting rules?
      - Because you had to comply with the other rules of the programme?
  - Selection: (by introducing an example)
    - Did you select these routines instead of other ones to conduct the activity/capability because you are supported by the programme?
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Preliminary Approach

Evolution of Organisational Routines

Retention
- Replication
  - Similar routines can be replicated in non-R&D divisions of the firm

Selection
- Artificial Selection
  - Selection of people, processes, etc. directly tied to the programme

Natural Selection
- Recombination
  - Recombination of the routines as imposed by the programme

Mutation
- Most of the unintended effects (‘slip-ups and lapses’)

Variation
- Introduction of new routines to the firm that could be attributable to support from the programme (creativity)

Migration/Diffusion
- Best practices are adopted by the programme

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