A multi-actor multi-criteria scenario analysis of regional sustainable resource policy

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A MULTI-ACTOR MULTI-CRITERIA SCENARIO ANALYSIS OF REGIONAL SUSTAINABLE RESOURCE POLICY

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Abstract

The increasing scarcity of natural resources (e.g. forests, energy, agricultural land) prompts the need to develop effective strategies for sustainable development at regional levels with a view to balancing the interests of different groups of actors or stakeholders. This study aims to address the stakeholders' multifaceted viewpoints on future sustainable development, mainly at regional scales. To this end, five experimental test cases – in the form of five different case studies in Europe – are analysed, so as to be able to investigate sustainability, as well as its main stakeholders, in different situations, and to encapsulate different sustainability approaches and different needs for sustainable development. A 'pentagon model' is used to represent systematically five critical aspects of sustainability. In order to analyse the trade-offs and synergies between different objectives (in particular, the viewpoints of different stakeholders) on sustainable development, four distinct scenarios – Competitiveness; Continuity; Capacity; and Coherence – reflecting distinct and relevant images of sustainability are presented. The relative merits of these four scenarios are then empirically assessed by means of a particular type of multi-criteria analysis, namely, Regime Analysis. The analysis is carried out by ranking different attributes of sustainable development, i.e. social, economic, ecological, institutional and physical, from the perspective of different stakeholders (distinguished, inter alia, according to gender, education level, occupation, institutional, and geographical background). This study maps out the different attributes of sustainability in relation to the viewpoints of different stakeholders in all five case-study areas. We find that the most preferred sustainable future is the Coherence scenario, in which a combination of ecological and social aspects is the most important determinant.

Keywords: Sustainable development, systemic approach, pentagon model, multi-criteria analysis, stakeholders.

1 Introduction

Since the introduction of, and increasing interest in, the concept of sustainability, politicians, researchers and citizens have been challenged to respond to the wide range of issues related to sustainability and sustainable development. However, basically, we all know that, deliberately or unconsciously, mankind is overusing the natural resources of our earth and enjoys modern technology which in most cases is not very environment friendly (in terms of the social, cultural and natural environment). In the 1980s, the UN General Assembly recognized that environmental problems were global in nature, and convened the Brundtland Commission to address this issue. The publication of the Brundtland Report (WCED, 1987) has become a milestone in the creation of a payback mechanism with globally – and locally – driven policies and to initiate new actions.

From the heated debate in the past decades, it has become clear that sustainability is a multi-attribute welfare concept (Peezey, 2004) and presupposes a self-organizing or self-adjusting concept with a dynamic meaning over time and space (see Reggiani and Nijkamp, 2009). Since natural or ecological processes and human activities are subject to the self-enforcing, self-organizing and self-regulating laws of nature, sustainable development has to find a balance between different conflicting objectives and related courses of action (Ruth, 2006; Bithas and Christofakis, 2006). There are, in general, multiple stakeholders, each having a specific interest or stake. The more absolute or comparative advantages that a particular natural or socio-economic constellation creates, the higher the number of stakeholders involved (Santos et al., 2006). Increasingly, participatory approaches in policy development have been advocated on the grounds that complex, multi-attribute issues should not be evaluated on a one-dimensional basis, but require the consideration of the diverse perspectives and viewpoints of different stakeholders (de Marchi and Ravetz, 2001). This pluriformity calls for novel and appropriate analytical decision-support tools.

This paper deals with the design of rational future choices represented by a set of distinct sustainable scenarios based on different stakeholder opinions. The originality of this study is the assessment of sustainable development strategy alternatives in cases where economic, social and environmental systems play interchangeable roles, given the uncertainty of future sustainable choice options. Consequently, our study aims to take into account the different views of stakeholders in their search for future sustainable development, where the latter objective is multi-attribute in nature. It also serves to provide an operational test by applying an analytical apparatus to distinct empirical issues by considering five case studies (or areas) whose future developments are judged by means of four distinct scenarios which reflect a range of sustainability objectives. Altogether, this study uses the preferences and ideas from 172 stakeholders located in five

different countries in Europe[1]. To analyse the trade-offs and synergies that exist between different objectives (expressed in particular through the viewpoints of different stakeholders) for future sustainable development, four distinct and concrete scenarios, are designed and investigated with the use of a particular type of multi-criteria analysis, viz. Regime Analysis. The evaluation analysis is carried out with the aim of ranking these scenarios by using five distinct dimensions of sustainable development, i.e. social, economic, ecological, institutional and physical, from the perspective of different stakeholders.

The paper is organized as follows. Section 2 describes a systemic approach to sustainable development in order to grasp the different aspects of sustainability and to identify the critical factors for achieving a sustainable future. This information is used to systematically develop future scenarios, in relation to each of the case studies under consideration. Section 3 highlights the role and importance of a scenario approach in sustainability studies. Next, Section 4 assesses the four scenarios, which were evaluated by a wide range of stakeholders and provides the foundation for the research conducted. The paper concludes by identifying and interpreting possible sustainable futures and sustainability policies.

2 Sustainable Development: Critical Factors

The core of the sustainability challenge can be described as the problem of representing and analysing the interactions, behaviour and emergent properties of combined natural and social systems, and of providing decision makers with appropriate guidelines regarding the effects of various forms of behaviour or policy intervention. An important challenge is to understand these systems' complexities associated with sustainability, including the provision of information to help the relevant actors to develop transition strategies (Kates et al., 2001).

2.1 A pentagon of critical factors

On the basis of a range of policy case studies (e.g. environmental policy, urban policy, transportation policy or energy policy), it has been found that normally there are only a limited number of success factors which determine the functioning and outcome of a complex system. In practice, the number of composite success factors does not exceed five (Button, 1998; Capello et al., 1999). Therefore, we will present here five critical factors which are decisive for sustainable development and which can be identified using the 'pentagon approach'. This rather stylized approach is a systemic framework to determine

[1] This study, including the selection of the five case-study areas, originates from the EU-project SMILE, which aims to analyse the trade-offs and synergies that exist between the different objectives related to sustainable development.

the (most) critical success and failure factors and sub-factors for effective – in this case sustainable development – policies.

To identify, in the pentagon framework, the five main factors that contribute to the achievement of sustainable development policies, a wide range of information sources can be used. In this study, a first version was developed by means of a literature review together with additional empirical information from associated researchers. In the subsequent step, the model was validated and improved by information from (local) stakeholders and/or experts. This was done by extensive interviews with stakeholders and experts and, where appropriate, by using additional questionnaires. Through a combination of a qualitative and quantitative assessment of the outcomes, case-study-specific pentagon models were developed (for a more extensive description and methodological underpinning of this systemic approach, see Akgün et al., 2011).

The operationalization of this pentagon approach requires the decomposition of each of these five main factors into their detailed constituents. Information on perceptions or attitudes regarding these factors was obtained, inter alia, through interviews or questionnaires. Aggregation can then take place through multivariate techniques, e.g. factor analysis (see, e.g., Nunes, 2002).

2.2 Success and failure factors for sustainable development

To encourage or enforce sustainable development, effective policies, regulations and incentives are needed. However, governments – and the focus of their policies – can be subjected to change as a result of various unforeseen (inter)national circumstances and/or socio-economic developments. The economic crisis, for example, has changed the priority list of many governments, with serious consequences for their sustainability strategies. Clearly, the quality of policies and governance is important in this context. For example, the level of coherence and of the seamlessness of political decisions and actions is important to induce stable sustainable development. There is a significant risk that the pursuit of social, economic and even ecological sustainability at the regional level may actually lead to the unsustainable management of resources as a system (Knoepfel et al., 2007). Efficient incentives, transparency of measures, consistent sustainability goals in all policy fields, as well as proper regulatory systems, can all be seen as factors necessary for success. These factors can be even more important when the government cooperates with private partners. Public-private partnerships can improve the understanding and trust on both sides, and therefore the uptake of new (innovative) ideas in the business environment, as well as in the public sector (Abeysuriya et al., 2007; Venkatachalam, 2008; Dellas, 2011). However, this requires interaction between different policy levels (local, regional, and national) and between public and private partners.

Clearly, a quality governance system is pivotal for sustainable development (Paavola and Adger, 2005). Therefore, a first important factor for sustainable development is the *institutional* system. Its sub-factors have been defined as integration (of policies and governance), the quality of governance structures, as well as the continuity of governance and policies. From a policy perspective, trust and mutual understanding are very important to change business behaviour (Granovetter, 1985). This requires insight into the behaviour of SMEs and large firms, and into the structure of existing market networks.

Also the economic structure, including ownership issues, the presence of big international firms, and the influence of local firms may all significantly affect the arena for sustainable development. Empirical studies on environmental policies stress the predominant role of property rights for land and the means of production as a critical factor in policy implementation failures (e.g. Gottfried et al., 1996; Langpap, 2006). However, not only the economic structure but also the current economic climate, as well as the level of uncertainty may be relevant. Possible impacts of unexpected economic shifts (e.g. economic crisis, price changes), can negatively affect sustainable development. In addition, the current economic situation may change the priorities for sustainability of firms in trouble, but, more positively, it may also induce new changes and innovations. A second pentagon factor is the economic system. The sub-factors that are distinguished are diversity of *economic* activities and the level of uncertainty.

The implementation of innovation and change also depends on *social* values (Hernes, 1976). The basic quality of the social system, such as the level of education and skills, but also the demographic balance is therefore very important. When entrepreneurs and households are aware of the importance of sustainable development and if they are open to new ideas, this will encourage new developments. In addition, the presence of local leadership, especially to orient local knowledge, is also an important success factor (Ropke, 2005; Silvano et al., 2005). This is reflected in the pentagon as the social system. It is related to the quality and solidity of social networks, their coherence, and also their continuity. The sub-factors are defined as social capital, openness, participation and awareness.

Another important aspect of sustainability is the quality and quantity of ecological areas and the resilience of ecological processes (Ward and Pulido-Velazquez, 2008). Synergies between protecting natural/cultural heritage and sectoral economic development (e.g. tourism or land-based industries) can ensure success in sustainable development (European Commission, 2010). Furthermore, in many cases the condition of eco-systems depends as much on specific environmental protection policies as on the effect of an increasing number of non-environmental policies such as those concerning agriculture, energy and transport (Gerber et al., 2009). Therefore, insights into the current

state and resilience of local/regional ecosystems, as well as into the (economic) benefits of ecological values can help effective decision-making and improve balanced sustainable development (Nunes, 2002). These are included in our model as the *ecological* system. We distinguish the sub-factors quality and quantity of ecological systems.

A final important and noteworthy factor in sustainability strategies is the structural socio-economic and technological condition of the studied regions, such as the level of development, the ease of accessibility, and the condition of different types of infrastructure (e.g. telecommunication; transport). This factor is vital for the optimal use of the capacity of the region, and thus for reaching the efficiency and productivity necessary for sustainable development (Small and Jollands, 2006; del Rio Gonzalez, 2009). Efficiency and effectiveness are preconditions for any morally acceptable resource use inefficiency and ineffectiveness imply waste (Ruth, 2006). In our model this factor is referred to as the *physical* system. Sub-factors are the level of accessibility, the quality of infrastructure and built environment, as well as the level of technology adaption.

Figure 1 summarises the Pentagon model with the success factors and their detailed constituents. I should be noted that the field work – based on survey questionnaires – contained a much more detailed description of the relevant attributes.

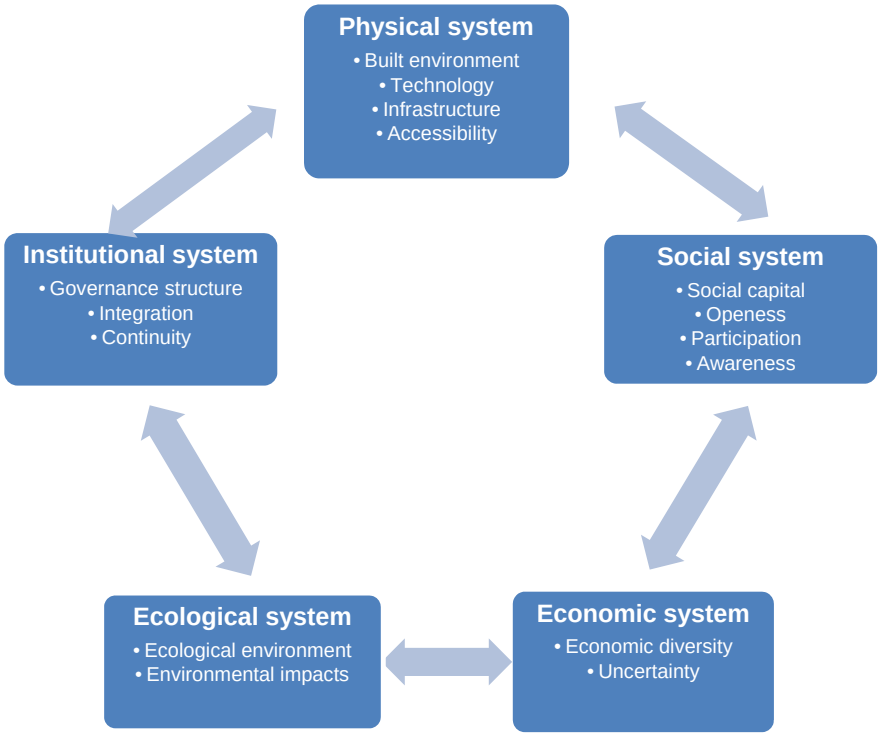

Figure 1. A pentagon of five critical factors for sustainable development

3 Using Scenarios for Sustainable Development

3.1 Forecasting and scenarios

Because of their complexity, sustainability transitions require a specific kind of intervention support, i.e. a transition management. Future studies in general, and scenario construction in particular, have been designated as essential components of appropriate transition support (Wiek et al., 2006). To inform decision makers about future developments, several techniques may be used by policy makers and organizations in both the public and the private domain. However, one of the major flaws in established analytical techniques, such as forecasting, is that relatively robust patterns extrapolated from historical events and processes are imposed with the implicit assumption that the world will remain relatively stable, and that the future is predicted based on events of the past (Allwood et al., 2008). One instrument that has been explicitly developed to think about different and extreme possible futures is the scenario approach, which aims to picture distinct and sometimes extreme future situations. Scenario analysis is a scientific approach based on the intention to design and judge possible future images as a frame of reference for current future-oriented decision making (for an extensive review, see Nijkamp et al., 1997). Gallopin has stated that the scenario approach can provide a common framework for diverse stakeholders to map and address critical concerns and identify alternatives, as well as a forum for discussion and debate (Gallopin, 2002). Over the years it has become an indispensable instrument for both private and public strategic policy making. For example, Shell introduced scenario planning in the private sector a long time ago, and has been using it for strategic planning since the 1960s (Ringland, 2002). It should be noted however, that scenarios are not actual forecasts or predictions of future developments, but rather descriptions of how the future *might* unfold, by mapping out the 'possibility space' of future developments (Giaoutzi et al., 2012). Instead of deterministic, stochastic, or blueprint planning techniques for short- to medium-term policy issues, scenarios are operational tools for complex decision making marked by long-term and largely unpredictable uncertainty, where the envisioning of future developments is necessary. Scenario analysis is thus a knowledge-based rational tool to explore uncertain futures, with the aim to respond appropriately to future challenges.

3.2 Benefits and categories of scenarios

The most important benefit of scenario analysis is its potential to provide new insights into possible policy pathways by answering 'what if' questions. In addition, it can form a frame of reference for evaluations and judgments through impact assessment of potential future developments. Furthermore, scenario analysis can help to organize a variety of seemingly unrelated economic, technological, political and social information, and translate all this into a

coherent framework for judgment. By doing this, societal and political choices can be grounded more soundly and be better explained to the public, thereby increasing transparency. Moreover, it can help in conveying messages to, and increasing the awareness of, various social groups in a participatory context (Nunes and van der Bergh, 2001; Giaoutzi et al., 2012).

In general, three different categories of scenarios can be used: 1) descriptive vs. normative*; 2)* projective vs. prospective*;* and *3)* common-sense vs. expert-based. In the first category, *descriptive scenarios* are mainly based on know-how about past and current trends. Apart from conventional wisdom, no major changes are assumed. On the other hand, *normative scenarios* focus more on the desirability of a development or choice (for example, by using norms and values from stakeholders or respondents). In this way, several – sometimes contrasting – scenarios can be constructed.

in the second category, *projective scenarios* are based on forecasting, starting with the current situation, which – together with the impact of future trends – leads to a future image. This approach can be rather conservative, giving limited scope for imagination. *Prospective scenarios* are based on back casting, in which first the situation in the future is described, and then the pathways (e.g. policy measures or societal changes) leading to it are presented. In this way, there is more possibility for imagination and an open mind. Consequently, these kinds of scenarios are often normative in nature.

In the third category, *common-sense* oriented scenarios use existing views and opinions shared by the majority of the population to build new futures. These kinds of scenarios may easily enjoy public support. *Expert-based scenarios* use the views from experts in a certain field who are supposed to be able to develop realistic and creative images of the futures without being constrained by current ideas.

Thus, scenarios can be very useful and powerful instruments for complex decision strategies, if they can provide new insights into possible paths and policies and their impacts on future situations. However, even though scenarios may be speculative and sometimes artistic in nature (e.g. by using computer images), they are constrained by various factors, as they have to be relevant to the policy issues concerned, have to find their roots in current situations with a complex force field, have to be internally consistent, and have to be based on the current state-of-art knowledge. All this can certainly limit the degrees of freedom in scenario building.

3.3 Sustainable development scenarios

In order to understand the position and expectations of different stakeholders in relation to sustainable development, in our study we have developed four scenarios using the critical factors for sustainable development identified in

Section 2.2. These scenarios are normative in nature, as well as prospective. They do not start from the current situation and are not based on projections of current developments. Instead, both common-sense and expert opinions are used to describe possible future directions. In this way, we were able to describe a set of hypothetical development alternatives for a complex system in order to generate a consistent response to future uncertainties and backgrounds, so as to ease and optimize the learning mechanism for both decision makers and policy makers (Finco and Nijkamp, 1999; van Hemert and Nijkamp, 2007). For a sustainable future, referring to the results of our research, we have developed four sustainable development scenarios on the basis of a literature review and of the viewpoints of experts about the five pentagon factors. Each scenario takes as its point of departure an emphasis on one particular pentagon factor-oriented future. Although we originally had five success factors, the factor related to the physical system is more a complementary or facilitating factor of the other four, so that a specific scenario for this factor was not designed as a possible future. Therefore, we have developed in total four strategic scenarios. These four scenarios are:

Scenario 1: Competitiveness (economic and social). The main aim of this scenario is to reach sustainable development by first improving the economic situation. This means that, apart from creating a healthy physical system, uncertainties in, for example, prices will be decreased and the economic diversity of sectors will be optimized. In this way, the economy will be less sensitive to economic crises, and income will be more equally distributed. As a result, the quality of social networks will improve, while budgets and technologies will be available for the protection of the ecological environment. This will then result in stronger competitiveness and sustainable economic development.

Scenario 2: Continuity (institutional and ecological). The main aim here is to protect the natural environment, as well as the diversity of ecosystems. Therefore, this scenario focuses on an increase in ecological quality and the choice of environmentally-friendly sectors for economic development. In order to achieve this, there is a need for a high level of administrative and management involvement, in terms of the effectiveness of policies, sustainability inclusion, continuity and integration of institutional systems in the sectors concerned, and sustainability. Both continuity in the institutional system and developments related to the ecological system are indispensable.

Scenario 3: Capacity (ecological and economic). The main aim here is to obtain a high-quality natural environment, as well as a healthy economic and physical environment. By focusing on both economic and ecological development, the capacity of an area will be increased. Often those two aims can be integrated by using environmentally-friendly ways of producing products. This means that

producers should not only choose environmentally-safer inputs for production, but also cut back on unnecessary waste and transport movements.

Scenario 4: Coherence (social and ecological). The main aim here is to first develop the social environment in terms of the quality of, and trust in, social networks, for instance, by increasing the awareness of sustainable development in general, and of the importance of ecological and social networks more specifically. Therefore, investments in education levels and skills to use new technologies are very important for all age categories. As a result, the level of tolerance and openness of society to new developments and the level of involvement and understanding will be increased. This will then lead to the protection of the ecological environment and a decrease of negative environmental impacts.

The scenarios differ in the relative importance given to each of the five factors. Clearly, they are not entirely mutually independent, but offer a particular perspective on the future state of a complex social-economic-ecological-institutional system. Based on expert opinion, the various factors were ranked (in order of importance) for each of the four scenarios (see Figure 2). This information was also provided to the respondents representing the stakeholders in our case studies. For instance, the most important factor for the Competitiveness scenario is the economic system. In other words, in the first scenario the main focus is on the economic system in order to obtain a sustainable future. The remaining scenarios were also scored by five critical factors in the same way. Altogether, this leads to a visualisation comparable to what is called the impact matrix in a multi-criteria context. This will be further analysed in Section 4.

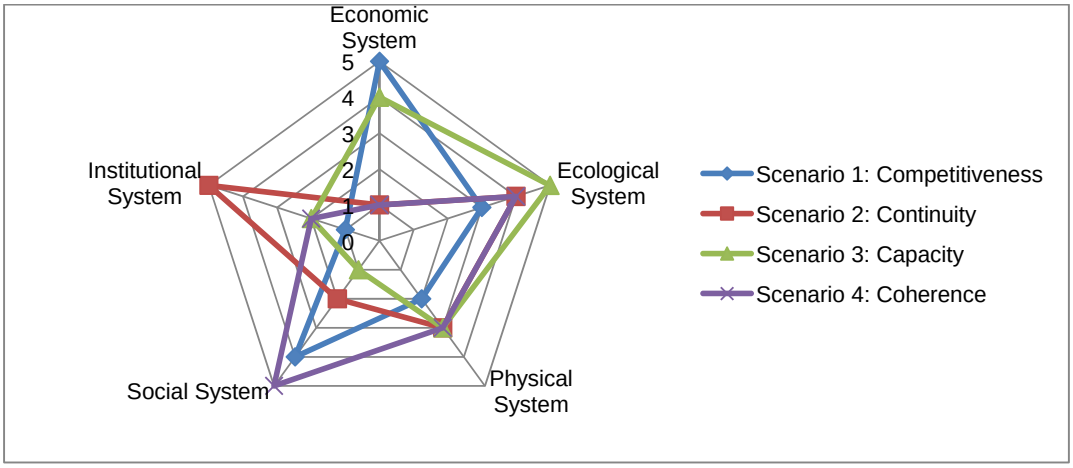

Figure 2. A Spider representation of the four scenarios

Note: the systems are prioritized on a scale ranging from 0 (low) to 5 (high).

4 Assessment of Scenarios: a Multi-Criteria Approach

4.1 General framework

In order to understand the viewpoint of stakeholders in terms of future sustainable development, in total five steps need to be taken (see Figure 3). Our approach started with a systemic approach to sustainable development: the formulation of five critical success and failure factors and the development of four related scenarios, as described in Sections 2 and 3. The impact matrix is composed of elements that measure the effect of the five factors with respect to each policy-relevant scenario. The rankings incorporate information concerning the relative importance of the four systems in the evaluation. Secondly, in order to identify the different viewpoints on sustainable development among various groups of stakeholders, a questionnaire was designed and administered. It was sent out in October 2010, in the form of a digital questionnaire to carefully selected stakeholders in the five selected case studies. The questionnaire was designed to take about 10 to 15 minutes to complete and had the aim to collect a wide range of the different stakeholders' opinions and experiences regarding sustainable development. The questionnaire consisted of four parts. First, the respondents were asked to express their views on the relative importance of the five factors compared with each other (pairwise comparison). Secondly, they were asked to rank various aspects of the five factors. The third part showed the four above mentioned scenarios that described alternative ways to reach sustainable development. The respondents were requested to allocate 10 points over these four scenarios. They could choose to give all their points to one scenario or split them up over multiple scenarios. Finally, in the last part, we asked them relevant personal questions, such as the institution where they work and their level of education. In England and Finland an English version of the questionnaire was distributed; in the other three case-studies it was translated into the national language. Stakeholders had the choice to fill in the form online or in an attached digital text document. Our general target was to obtain approximately 50 returned questionnaires for each of the five case studies. Due to the pluriformity in case study approaches, there was a broad range of useful completed forms, viz. Finland: 18; Italy: 55; Scotland: 34; Romania: 52; and Spain: 13, making a total of 172 replies (see Appendix 1 for an overview). The average response rate was 29 per cent.

Next, in order to identify the best-fit scenario or to express the overall sustainable choices of stakeholders, a multi-criteria analysis (MCA) was used; in this particular case, the Regime Analysis (RA) was chosen. The third, fourth and fifth research steps are based on this specific multi-criteria analysis (MCA). In general, an MCA is essentially based on a multi-attribute representation of the multifaceted aspects of choice alternatives that contribute to social welfare. There are various MCA methods (see, inter alia, Munda, 1995; 2004; 2006), but in this study we applied the Regime Method. The Regime method presupposes a

distinct set of a-priori defined alternatives and a distinct set of a-priori defined evaluation criteria for all criteria together. When combined, this leads to what is called the 'Regime matrix'. By then adding a weight vector, the relative dominance of each alternative can be assessed in the form of a performance (or success) rank order. RA is a discrete multi-criteria method, whose main advantage is that it is able to cope with both qualitative and quantitative effect information (for a detailed exposition, see Hinloopen et al., 1983; Nijkamp et al., 1990). It uses pairwise comparisons to assess the performance of alternatives, while outranking relationships are built between the alternatives (Nijkamp et al., 1990). The basic mathematical framework of the method is consequently based upon two kinds of input data: an impact matrix, and a set of (politically-determined) weights. Figure 2 basically shows the aggregate impact matrix which was used in the RA. The impact matrix is composed of five elements (here, critical factors) that measure the effect of each considered alternative in relation to each policy-relevant criterion (in our case, these are the four scenarios). RA is an appropriate approach here, as the nature of the analysis fits our aims perfectly. First, it deals with the relative importance of the effect of the systems of sustainable futures developed above, and, secondly, it describes the performance of each scenario in terms of preferences in qualitative (rank-order) terms.

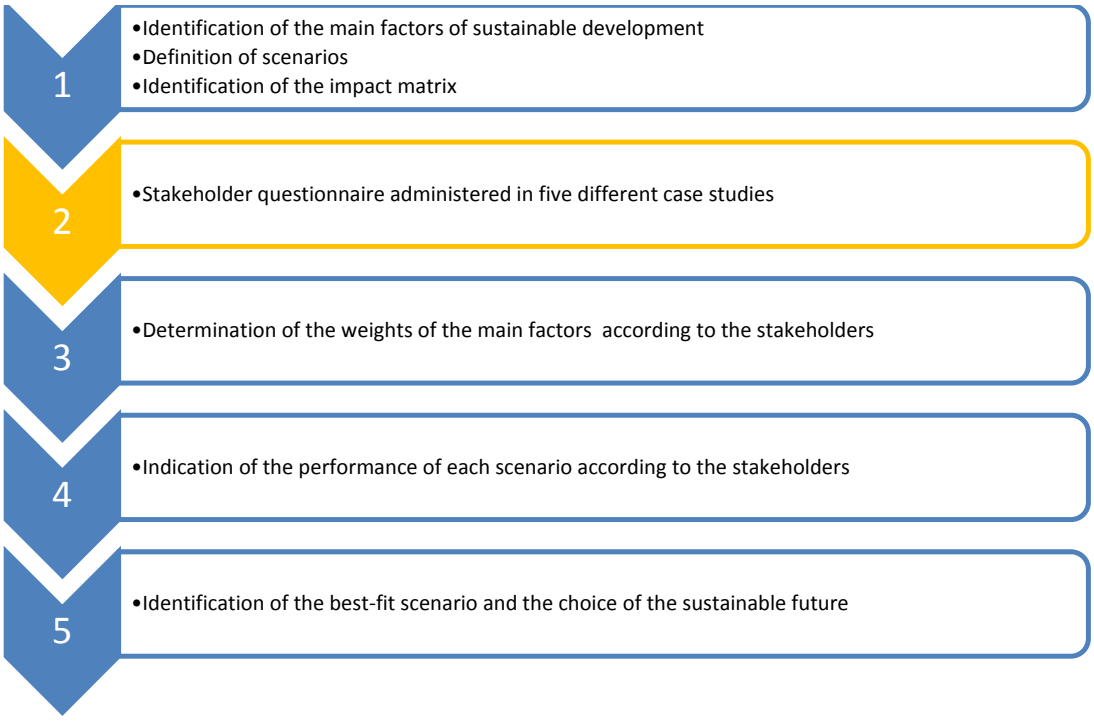

Figure 3. The five steps taken in the research framework

In the third step, the importance and criticality of each system is analysed. Therefore, we determine the importance ranking of each critical system as

indicated by the stakeholders based on pairwise comparisons, which provides the weights of the factors concerned.

In the fourth step, the results of the RA provide insights into the relative performance of each scenario on the basis of the weights assigned to each critical attribute system. Weight groups are formulated on the basis of the pairwise comparisons of stakeholders groups. This step thus shows the sustainable future preferences of each weight group.

In the fifth and final step, we evaluate the results and recommend the best-fit sustainable future from the perspective of the stakeholders.

4.2 Case studies

The case studies employed in our research are clearly diverse in terms of sustainability issues, aims, stakeholders and scales. This is summarized in Table 1, which illustrates the complexity and diversity of our sample of five cases. The case studies in our sample also have various similarities; the main similarity is that their general approach is sustainability-oriented. The sustainability issues are mainly based on ecological and economic aspects of sustainability. Except for the Spanish case study, all case studies are sector-focused.

Table 1. Summary of the case studies

Case	Aim	Scale
Finland	Forest ecosystem	National
Italy	Agricultural sector	Local, Regional, National
Romania	Energy sector	National
Scotland	National Park	Regional
Spain	Toolkit	No scale available

The selection of case studies had to fulfil our general aim for the creation of a multidimensional, multi-asset research approach to sustainability. In other words, each case study had its own sustainability issue which, with the application of the MCA and our general conceptual framework, was supposed to demonstrate that the understanding of sustainability also depends on the characteristics and perceptions of stakeholders. Clearly, our objective was to show that it is possible to come up with a commonly agreed sustainable future scenario for a better ecologically and economically developed world. We now briefly describe our five case studies. It should be noted that these five cases were not meant to be mutually comparable, but to offer a variety of conditions though which general future sustainability lessons could be inferred.

The aim and focus of the *Finnish case study* is the sustainability of the forest ecosystem and its utilization by humans. This case study is a nationwide case study for the next 20 years. The main sustainability target is to assess the ecosystem's well-being: the possibilities to regenerate and sustain ecosystem quality. When asking the stakeholders about whether sustainability has increased in the Finnish forest sector, it was often mentioned that it is important to separate ecologically sustainable development and economically sustainable development, since the Finnish forest sector is still very traditional and even today focuses on maximizing loggings and the economic benefits. Therefore, the Finnish forest sector is not really becoming more sustainable from an ecological viewpoint (but neither is it becoming less sustainable), because the biodiversity, especially in southern Finland, is still under threat due to heavy logging. Nevertheless, waste reduction, emissions reduction, and efficiency improvements have taken place. Economically, there is a risk that the Finnish forest sector will lag behind, if new ways of thinking about the forests as natural resources are not adopted. The technology is not significantly improving, and thus its sustainability remains about the same. The crucial question is that of the magnitude of production that determines the total environmental stress caused by the forest industry, including in terms of the energy (electricity) used by the factories themselves.

Sustainability issues of the *Italian agricultural sector* are mainly related to the trend of abandonment of land by farmers and of related land use change. This phenomenon takes place as a result of several factors: among others, the low economic profitability; land pollution by industrial activities and inappropriate disposal of solid and liquid waste from industrial and urban systems; distance from main trade and use centres; and urban and road system expansion. Land use change "unbalances" the social structure of the region: people concentrate into cities and lose previously existing income opportunities while looking for new ones. The present challenge for agriculture is to generate income by enhancing its multi-functionality patterns (food, bioenergy, bio-fertilizers, environmental services, biodiversity conservation, etc.).

The main target of the *Romanian case study* is to analyse the socio-economic system's metabolism – integrating the social, economic and environmental aspects – of Romania by focussing on energy flows. The Romanian case study has a national scale because of the broad societal involvement of various actors, topic-related ministries, households and action groups, local authorities, and companies. At the moment, the energy sector in Romania is non-sustainable and is experiencing high energy and economic losses, while the urban energy sector has almost suffered an economic collapse. The rural energy sector is not included in broader energy programmes, and many decisions have been delayed (especially regarding energy generation); there is a serious financing shortfall

uncovered by programmes and funds. Most current actions are oriented towards maintaining the status quo, and not towards transformation.

The *Scottish case study* focuses on assessing the trends in the Cairngorms National Park (CNP) and the delivery of the National Park (Scotland) Act via the Cairngorms National Park Plan. In general, the perception is that Scotland is becoming more sustainable. The concept is taken very seriously today. There is pressure on society to look at resource use and reduce waste. Also the perception of the CNP is quite positive. It seems that currently significant work is being done to preserve the ecosystems present in the Park, balanced with economic development. The National Park has great potential for good practice; both the park staff and the private sector are innovative willing to take risks. However, it is difficult to see exactly to what extent the national park authority is influencing sustainable development, while also the large share of external funding could be seen as (economically) unsustainable.

The *Spanish case study* is the most distinctive of the case studies. It deals in particular with the design of the methodology, and consequently concentrates less on specific aspects of sustainability. However, it is useful in providing the relation between the methodology and sustainability issues. In other words, the Spanish case deals with how to calculate and measure sustainability-related issues, and, most importantly, how to present the results in a more transparent way to the stakeholders.

As can be seen, the case studies have several geographical scales. Some deal with the national scale, while the other case studies focus on local or regional scales. In addition, they are different in nature in that some include stakeholders in the analysis process and work with them, whereas others do this less so. In the Spanish and Finnish case studies, stakeholders are included in the consultation process, but are not directly involved in the analysis process, while the output of both cases is useful for many stakeholders.

4.3 Integrated assessment scheme

Our empirical analysis is characterized by a high degree of pluriformity, as it is based on a multi-perspective approach characterized by:

- Five environmental case studies from different countries in Europe;
- Four future strategic scenarios which map out various images related to sustainability objectives;
- Five overall assessment criteria for evaluating the performance of individual scenarios in each of the case study areas;
- 172 stakeholders in the five case study areas who are inter alia asked to provide their views (‘preference elicitation’) on the importance of the five pentagon factors in relation to the four scenarios, against the background

of their expertise on the particular national case study under consideration.

This leads to the integrated assessment scheme shown diagrammatically below (see Figure 3).

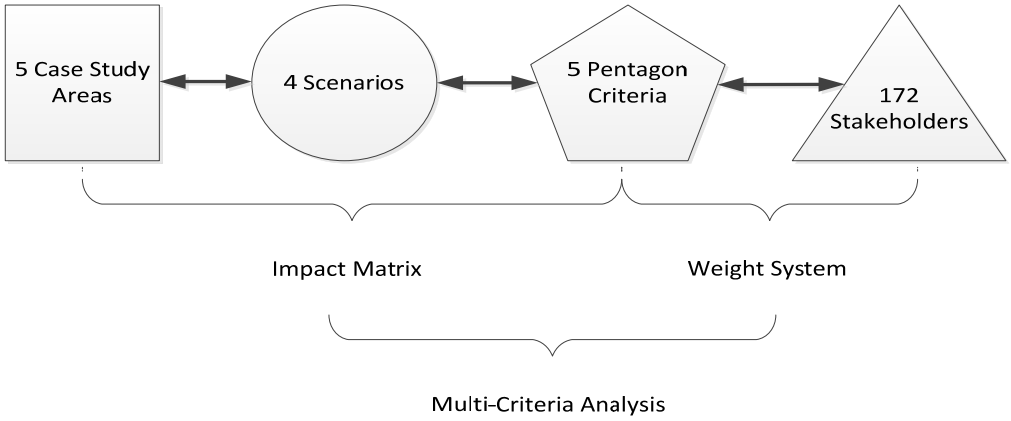

Figure 4. Evaluation system for sustainability strategies

The main goal of the multi-criteria analysis is not to identify the most successful case study area, but to identify the most appropriate and most highly regarded scenario that may serve sustainability purposes in all case studies under consideration. This will be further operationalized in Section 5.

5 Empirical Results

In Section 3 we presented four sustainable development scenario alternatives in order to identify the best-fit sustainable development scenario, and to see which stakeholders prefer which scenario alternative, and how they rank them according to their perceptions. The next step is to apply RA to these findings. In RA, we need two different information matrices: one corresponds to the sustainability alternatives and the underlying evaluation factors – that one was already shown in Section 3 where we explained the scenarios; and the other one is the weights matrix – the perception or preference elicitation of stakeholders. While collecting our data about the prioritization of the pentagon factors depending on the perception of stakeholders, we used a pairwise comparison technique. In this way, we were able to calculate the weights for each factor, based on a ranking/set of prioritization of factors by different groups of stakeholders. The set of weights incorporates information concerning the relative importance of the criteria in an evaluation of the scenarios.

By using the weighted average of the pairwise comparison of different stakeholders, we can generate a prioritization table of pairwise comparisons, after which the ranking of the factors takes place. While doing so, we can also

differentiate the weight sets depending on the profile of the stakeholders, and also on the case study to which they belong. Therefore, we are able to obtain four sets of weights for the case-study-specific sets, and four sets for the different profiles of stakeholders (see Table 2). Basically, these sets correspond to the priority rankings of the five pentagon factors. During the formulation of these sets, we decided to use an 'equally important ranking' when the stakeholders were not consistent in their pairwise comparison (i.e. in case of intransitivity conditions). In other words, when a stakeholder evaluates social systems more important than economic systems, economic systems more important than ecological systems, but ecological systems more important than social systems, this means that the ranking of the stakeholder is inconsistent and hence all factors are equally weighted for this stakeholder. Apparently, he/she cannot decide which one is more important than the others.

Table 2. Set of weights – Prioritization of Pentagon factors

Profiles of Stakeholders		
Set 1.1	Education: Bachelor and High school or Less Occupation: Students Institution: Other	All factors are equally prioritized.
Set 1.2	Gender: Female and Male Education: Master, Doctorate Occupation: Manager, Researcher, Other	Ecological and Social systems are the most important and the next most important factors (Ecological>Social>Physical = Institutional = Economic)
Set 1.3	Education: Other Institution: University and state employees, NGO	Social, Physical and Economic systems are equally important factors (Social=Physical=Economic)
Set 1.4	Institution: Private	Physical>Social>Economic>Institutional>Ecological
Country of Stakeholders		
Set 2.1	Country: Italy and Romania	All factors are equally prioritized.
Set 2.2	Country: Finland	Ecological>Physical>Social>Institutional>Economic
Set 2.3	Country: Scotland	Ecological=Physical=Institutional=Economic>Social
Set 2.4	Country: Spain	Physical>Ecological>Economic= Social= Institutional

These sets basically show that, although stakeholders can be grouped depending on their profiles, the understanding of the private sector workers remains distinct from the others. In addition, the country-based evaluation shows that, except for Italy and Romania, each case study is unique in itself.

The first Set (1.1) we can distinguish in terms of the profile of stakeholders is the one where all factors are equally weighted. All factors are then equally prioritized in favour of sustainable development, i.e. by the educational groups of High school or Less educated and Bachelor degree graduates, by students, and

the institution group other, while, among the countries, Italian and Romanian stakeholders think the same way and prioritize each factor equally.

In terms of gender, both female and male stakeholders believe that ecological systems are followed in importance by social systems and physical systems, which are considered to be as important as institutional and economic systems (Set 1.2). University, state and NGO employees have similar preferences: they rank social, physical and economic systems as equally important (Set 1.3), while employees of private institutions consider the physical systems as most important, followed by the social, economic, institutional and ecological systems (Set 1.5).

Although there is a remarkable difference in the perception of stakeholders by country, it can be seen that the stakeholders in our sample can be easily grouped by their profiles. Therefore, we can come up with a preliminary conclusion that, although there are diverse sustainability problems and issues, what people decide about the future depends on their profile rather than on their country. Thus, a common sustainable future seems possible.

On the basis of the stakeholders' prioritization and the impact matrix, we are now able to apply our RA. We ran the analysis for each set of priorities separately and organized the performance indicators of the four scenarios calculated for each group within a histogram (Figure 5). According to the results of each group's preferences, the fourth scenario, Coherence, is the one most preferred by the majority: it gives more priority to the social and the ecological system than to the other systems. On the other hand, the first scenario, Competitiveness, which puts more stress on the economic and social aspects of the future, is the least preferred scenario.

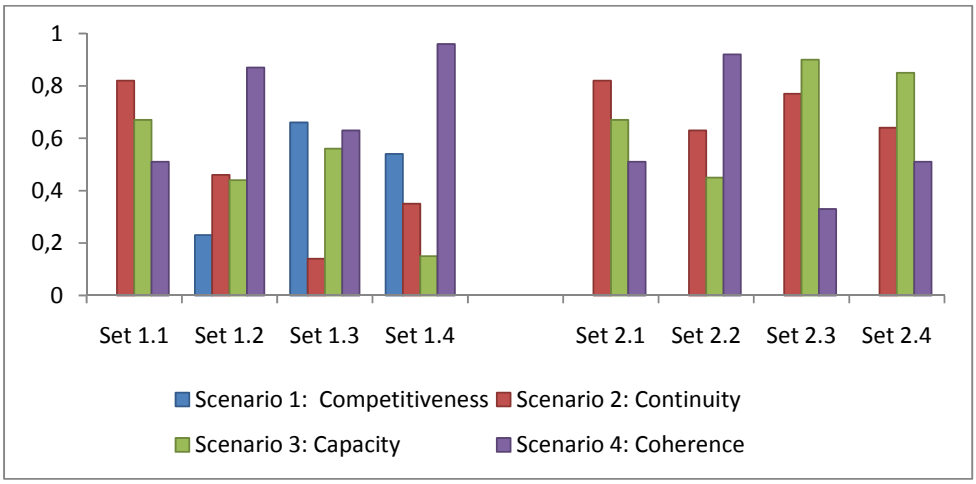

Figure 5. Scenario choices of different stakeholders

Figures 6 shows, first, the composition of the scenarios by factors, and below that it visualizes both the prioritization of the pentagon factors by each set of

stakeholders (with 5 being the most important factor), as well as the score they gave each scenario, now represented by separate symbols on a scale of 0 to 1. In this way, we can check the consistency of the answers, and how asking questions about separate factors leads to different results than when asking about integrated scenarios.

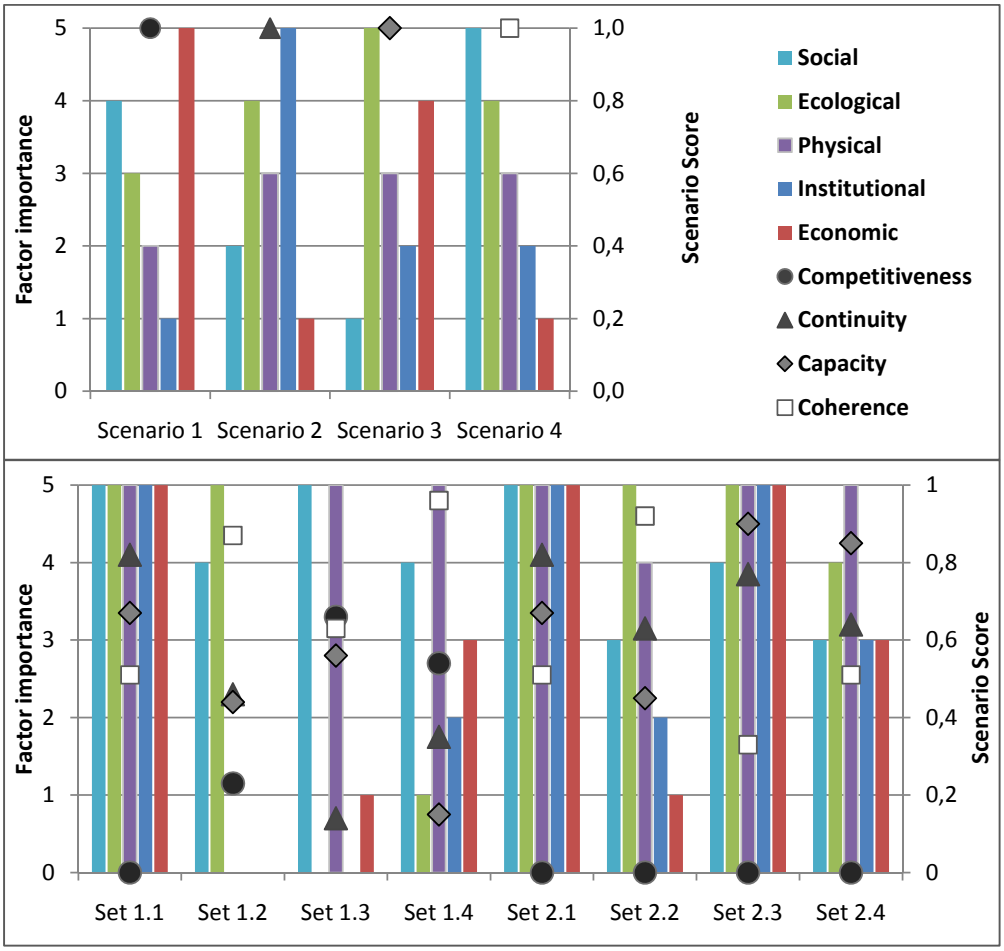

Figure 6. The stated importance of the separate factors with the scores for the scenarios for each set of stakeholders.

When we look at the separate sets we find some very interesting solutions. For instance, groups of stakeholders that state that all factors are equally important (Sets 1.1 and 2.1) prefer the Continuity scenario rather than the Coherence scenario, and do not give any credits to the Competitiveness scenario. This is an interesting result, as these stakeholders – although they find all factors equally important – in fact believe that ecology is the most important factor for a sustainable future, and therefore eliminate the scenario that does not give importance to ecology. In addition, the sets which give a primary or secondary priority to the social systems factor rank the Capacity scenario (score 3) among possible futures, and Set 1.3 even gives a score of 0.56. Private firms, Set 1.4 are relatively consistent when prioritizing. Their employees give more importance to

the social and the physical system (not shown in the figure), and have a preference for the Coherence scenario. Also Set 1.2 gives priority to the ecological and the social factors, together with the Competitiveness scenario.

When focusing on the country sets it appears that Italy and Romania (together in Set 2.1), as well as Scotland (Set 2.3) find all factors important, but give relatively low priority to the Competitiveness and the Coherence scenarios. Apparently, after all, ecological and institutional factors are more important than the others. According to the Finish stakeholders, social and ecological factors are most important to reach a sustainable future, which is in line with their high prioritization of the Coherence scenario.

The results show that, basically, the ecological system has priority from the perspective of stakeholders, based on each case study evaluation. But, actually, the most preferred future scenario puts the ecological system as the second priority, rather than the social system which is usually the second priority factor indicated by the stakeholders. In addition, another interesting result is that – although in the future the physical system does not have a high priority – stakeholders and also countries may evaluate the physical environment as being preferred to the ecological environment. This result basically reflects the main and basic meaning of sustainability, i.e. that the physical system is more related to the current quality of life, while the ecological system is more a concern for future generations.

6 Concluding Remarks

Sustainable development creates the possibility for diverse systems to improve the cohesion between past and future, social and economic systems, and many others. This type of multi-systemic/multidimensional phenomenon calls for a multi-stakeholder involvement to facilitate policy implementation. In this study, we have considered the opinions of stakeholders about future sustainable development in order to be able to ascertain favourable sustainability policies.

By using an MCA, we were able to test the feasibility of four scenarios by considering the opinions of stakeholders that shift between boosting economy-oriented policies to improving education, while social quality is seen as an instrument to protect the ecology. The results of our analysis prove the usual assumption in the literature about sustainability, i.e. that policies may differ depending on the sustainability concerns in the government's agenda. But from the perspective of stakeholders, there is one unambiguously and most desired sustainable future: that is, a future where the ecological system can survive with a great coherence of social life.

The robustness of our study comes from the use of a scenario-based approach, in order to take into account the diversity in opinions of a great spectrum of

stakeholders. Nevertheless, we can still come up with generalized sustainability policy lessons. Basically, this is a process to be learned and followed, and the first thing to do is to deal with education. Therefore, our prominent policy lesson is to focus on education and training of society, as well as to encourage participation of citizens in discussions or actions related to sustainability. These educational and social improvements will enhance the health, diversity and productivity of the environment to the benefit of future generations. On the basis of these lessons, a sustainable and ecological way of producing needs to be advocated and stimulated among the business sector. There is indeed a challenging policy and research agenda ahead of us.

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Appendix I. Overview of stakeholders in the sample

		Finland	Italy	Romania	Scotland	Spain
Gender	Male	7	32	32	11	4
	Female	11	23	20	23	9
Institution	Research	10	27	13	0	10
	Private firm	1	4	9	11	0
	Government	6	1	23	5	1
	NGO	1	4	0	6	0
	Other	0	19	7	12	0
Education level	Low/middle	0	2	7	13	2
	Bachelor	10	22	22	7	7
	Master/Doctor	8	31	23	14	4
Total		18	55	52	34	13

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