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Disciplinary integration and networking between expert authors in the development of the UK National Ecosystem Assessment: Summary of findings

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A sample of 38% of coordinating, lead and selected coordinating authors took part in a mixed method quantitative/qualitative post-project assessment web-based survey.

My research focused on three main areas:

In the quantitative stage, sampled authors provided data in on the most common sources of expert information *outside of their own school of expertise* requested during their work authoring the UK National Ecosystem Assessment (UKNEA).

Responses were divided and analysed according to: i) respondents own disciplinary and professional background; ii) the chapters they were involved in developing the UKNEA.

Qualitative responses focused on observed barriers to disciplinary integration and broader comments and recommendations on the UKNEA process.

Authors on the UKNEA were also asked to provide details of their preferred sources of information outside of their own area of expertise, as well as the reasons for their stated preferences.

1. Level of 'disciplinary integration' present on the UKNEA

Disciplinary integration was defined at the individual level as 'cross-disciplinary networking': the seeking of expertise outside of the broad disciplinary background of the individual author. For example, where an author from the disciplinary background of economics or social science most commonly sought expertise from natural science disciplines, this was classed as *interdisciplinary* behaviour. Where a natural scientist most commonly sought expertise from other natural scientists this was classed as *intradisciplinary* behaviour.

The responses of individual authors on the UKNEA were aggregated. This data was broken down into different levels: i) UKNEA chapters (27 in total); ii) disciplinary background of the authors; iii) the project as a whole.

Disciplinary integration was classified according to a three point scale: from lowest to highest: multidisciplinary, interdisciplinary and transdisciplinary.

1.1 Disciplinary background of respondents

Respondents were found to stem from a range of disciplinary backgrounds. The most common were natural scientists (56%), followed by economic (10%), interdisciplinary (10%), policy (8%)

and social science (5%). The distribution of survey respondents by disciplinary background was not significantly different from that of the total population of UKNEA authors, as researched using the same web-based method ($\chi^2 = 0.201, df=7, p < 0.05$).

1.2 Most requested forms of expertise

Overall we found that scientific advice was the most commonly requested outside form of expertise across all disciplinary backgrounds (58%). The next most important form of outside expertise on the UKNEA was economic advice (22%). (Table A)

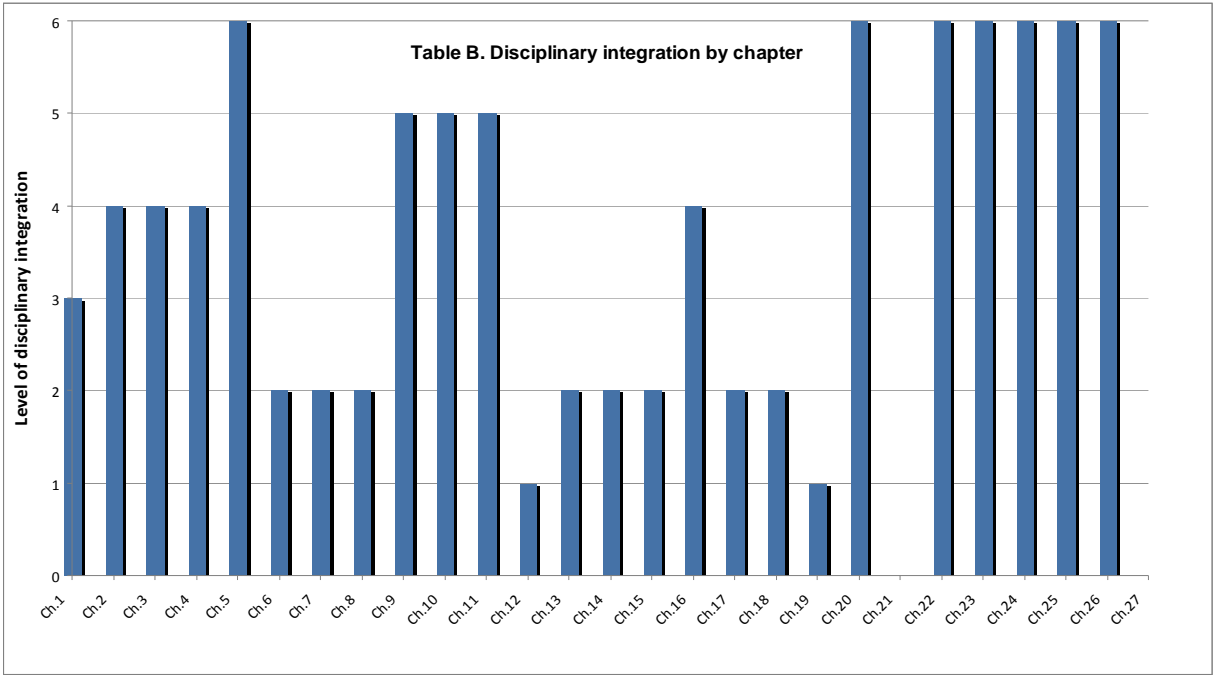
1.3 Disciplinary character of each chapter

Ten chapters displayed low-level disciplinary integration, against 14 with average to high (only 25 chapters returned data).

The latter chapters in particular (20, 22-26) were much more interdisciplinary, both in terms of chapter composition and author disciplinary-networking. Chapters 21 and 27 provided insufficient data for analysis.

Of those chapters with low levels of disciplinary integration (chapters 6-7, 12-15, 17-19), 28 % were predominantly natural science-based.

For chapter with average to high levels (chapters 2-5, 9-11, 16, 20, 22-26), 20% were natural science and 12% general social science. This difference was significant ($P = 0.000$, (2-tail test), Fisher's exact test). (Table B)



1.4 Interdisciplinary behaviour by disciplinary background

More *intradisciplinary* behaviour (seeking expertise within the authors own disciplinary area) was found among natural scientists, with 63% seeking expertise from within a scientific background.

In contrast 50% of the general social science group sought scientific expertise, in a way that could be defined as *interdisciplinary*. Statistically the inter- and intra-disciplinary relationship between natural science and GSSI was significant (Fisher's exact test, $p = 0.043$ [2-tail test]).

1.5 Disciplinary integration across UKNEA

Aggregated across project-level, 39% of the total population displayed 'interdisciplinary' behaviour (excluding those from other and undefined disciplinary backgrounds).

61% therefore showed low disciplinary integration behaviour.

Table A Disciplinary networking behaviour

Disciplinary source of expertise requested by respondent	Natural science authors	Natural science cross disciplinary networking ^a	General social science authors	General social science cross disciplinary networking ^b	Total
Scientific	27 (35%)		13 (17%)	13 (50%)	45 (58%)
Economics	7 (9%)		7 (9%)		17 (22%)
Social science	2 (3%)	17 (37%)	4 (5%)		6 (8%)
Policy	7 (9%)		2 (3%)		10 (13%)
Technical	1 (1%)		0		2 (3%)
Total	45	43	26	26	

1.6 Conclusions

The UKNEA displayed many of the characteristics of medium levels of disciplinary integration. The quantitative part of the method showed that the UKNEA incorporated participants from a wide range of academic fields, although the majority were from natural science and economics. At the level of individual disciplinary behaviour, only 39% of respondents most commonly sought interdisciplinary expertise. At the chapter level more chapters demonstrated average to high disciplinary integration.

I cannot conclude that the UKNEA achieved the highest level of disciplinary-integration (transdisciplinarity) for the following reasons:

- An overarching synthesis was lacking from the process;

- A chapter structure where one or two disciplines dominated encouraged disciplinary silos;
- Intra-disciplinary rather than interdisciplinary knowledge creation work was prevalent, especially in the natural science chapters.

2. Barriers to disciplinary integration

Table C shows a breakdown of the disciplinary barriers coded from qualitative responses to the online survey. Results are broken down by general disciplinary background to highlight any variances in responses between disciplines.

Code	Number of codings	General social science (%)	Natural science (%)	Other (%)
Language	17	53	57	0
Methodology/epistemology	15	47	47	6
Time	12	42	58	0
Hegemonic disciplinary Bias	11	45	55	0
Procedural issues	16	25	75	0
Size	5	20	80	0
Disciplinary integration vs. project delivery	9	66	44	0

- Different usages of language between disciplines, including different understandings of the same specialist terminology by different disciplines, was the most prevalent barrier cited (n=17).
- The second most prevalent barriers were those caused by different epistemological, conceptual and philosophical perspectives between disciplines (n=15). This code overlapped with language barriers in 11 cases.
- Time constraints were identified as a barrier by 12 respondents.
- Procedural issues related to administrative failure in the structuring of the UKNEA (n=16). Issues included: inadequate facilitating arrangements for project delivery and interdisciplinary networking; lack of goal alignment in a project bringing together so many different disciplines with differing language, methods and epistemologies; and need for clear definitions to be given ‘to achieve a joint goal’ (R51-NS).
- The chapter-structure of the UKNEA was also sometimes criticized: ‘The subdivision used to structure the NEA...limit[ed] interdisciplinary interchange in some areas’ (R74-Natural Scientist).
- Hegemony refers to the dominance of the ideas of one group over another. Comments which indicated that certain disciplines dominated the direction, terminology, scope and outcomes of the UKNEA were coded a total of 11 times. For some this took the form of hegemony of

methods, approaches and conceptual definitions. This produced narrow definitions of core UKNEA concepts, including the very concept of interdisciplinarity;

'Assumptions were made that those representing specific academic disciplines were the arbiters of current thinking in their disciplines. This led to orthodoxy, certainly with respect to economics... This meant that NEA could not easily stray outside the boundaries imposed by the disciplinary experts...[Barriers] were almost exclusively epistemological of nature and to be expected if top management- no matter how good - comes from one discipline.'(R24-Social Scientist)

- Some conceptualized UKNEA project management as operating with two distinct typologies for ecosystem services - one ecological and one economic – with other disciplines sidelined at the methodological and conceptual level. This led to an insufficient level of integration - a multidisciplinary approach - with important implications for the types of questions asked, the scope of enquiry and the format of the final report;

'The NEA was predominantly produced by natural scientists and economists. The engagement of other social scientists was limited because their approach, concepts and definitions were different from those becoming the 'ES currency' as reflected in the methodology chapter.'(R14-Social Scientist)
- Size: Comments indicating that the UKNEA was 'too broad in scope... to foster a good interdisciplinary approach'(R36-Natural Scientist) were coded 5 times.
- Trade Off: Disciplinary Integration vs. Project Delivery. A number of comments (n=9) questioned whether the very plurality of disciplinary approaches created barriers in the relations required for 'interdisciplinarity' (Box.3). Others conceptualized disciplinary-integration as a trade-off with timely project delivery, whereby investments of time, organizational resources and social capital divert resources away from the requisites of timely project delivery. This, according to some responses, accounted for the multidisciplinary structure of the project at chapter level. Table.B shows the number of coding observations for each category, alongside the disciplinary background of those respondents.

Qualitative findings at the disciplinary level showed that more natural scientists commented on the limited level of disciplinary integration on the project (81%). However, more scientists also provided evidence of disciplinary integration (50%). Coding related to disciplinary barriers was broadly equal across both groups.

More detailed qualitative analysis is available on request.

2.1 Conclusion

Dominant barriers which emerged were based around communication issues like language and methodology. Procedural issues like time constraints and size of the project were also important. In terms of institutional barriers, leadership and administrative issues, such as the structure of the project were a common them. One example was the silo effect of having research tasks largely demarcated at chapter level. This arguably assisted the ultimate aim of project delivery for a project of this scale. However, I believe this chapter structure accentuated disciplinary boundaries and obstructed genuine transdisciplinary integration. In addition, disciplinary hegemony was present, resulting in the dominance of methodological and conceptual foundations dominated by ecology and economics.

Barriers may also be inferred from the results of the previous section showing a greater number of natural scientists displaying intradisciplinary behaviour. In addition, of those chapters with lower levels of disciplinary integration, all were predominantly natural science based. This would appear to support the traditional disciplinary barrier to cross-disciplinary collaboration (Siedlok and Hibbert, 2009). It might also lead to a conclusion that social science disciplines are more readily facilitated into higher-level cross-disciplinary behaviour. However, one must account for the fact that 50% of general social science authors also displayed intradisciplinary behavior.

3. Forms of expertise communication

Data was gathered on the reasons that a particular source of outside expertise was used by authors on the UKNEA, and the communication form that this process took.

3.1 Information source

Table D shows the most common sources of information outside of the author’s own field of expertise. As would be expected from an expertise-centred research project like the UKNEA, the largest number of responses indicated that they sought expertise from academic sources, followed by in-house, and in third place government or civil service sources.

Table D							
In-house	Government/ Civil service	Academic	Expert panels/ working groups	Other intermediary organisations	Think tanks	Learned societies	Other
10	5	34	3	2	0	0	2

3.2 Knowledge transfer forms and reasons

Respondents also provided information on the communication forms and relations which sustained expert knowledge transfers. Respondents were requested to indicate the most common form by which communication with sources of expertise outside of their own expertise was maintained as well as the reason that this source of expertise was chosen (Table E, see below).

The most commonly cited form of expert knowledge transfer was direct personal contact. This was similar in character to the second highest, that of informal networks of personal contacts. Designated departmental liaison arrangements and working groups or expert panels were also mentioned frequently.

The reasons given for these knowledge transfer preferences were strongly related to previous experience, reputation and knowledge of available skills. Previous publications were also important, as too were personal informal contact networks.

3.3 Conclusion

The data in section three outlines clearly the importance of personal contact networks in the transfer of expert knowledge in cross-disciplinary projects like the UKNEA. It also shows the potential that facilitating arrangements like departmental liaison, working groups and panels, and knowledge of previous publications has on cross-disciplinary knowledge transfer.

4. General comments and recommendations

My conclusion is that although a medium level of disciplinary-integration was assigned, a number of provisions could be made at the individual and structural level to improve disciplinary integration. At the level of individual disciplinary-networking, institutional structures are required to support and encourage authors to seek expertise outside of their own discipline. Clear goal alignment is also necessary. This can be supported with a coherent, well-communicated conceptual framework of the disciplinary aims of the project, alongside a glossary of terms to assist trans-disciplinary communication.

The challenge for those commissioning and leading research projects of this type is how to ensure the objective of 'interdisciplinary' research is achieved. I propose the following indicators for chapter-structured knowledge creation projects like the UKNEA:

1. Chapter composition: 'Ensuring that people have to spend some time working a specific project with at least one person from another disparate discipline.'(R63-NS) Each chapter

could be given a ratio of disciplinary integration to achieve. Coordinating authors would then be given a mandate to include a set ratio of contributors from other disciplines.

2. Chapter integration: Coordinating authors must be able to demonstrate evidence of cross-integration between lead authors on their chapter, and those on other chapters in the project. This could be achieved using social network analysis (see below).
3. Individual networking: The presence of disciplinary networking should be monitored by coordinating authors. This would serve to assess the success of the social capital facilitation structures in place, and allow for additional encouragement in this area if required.
4. Leadership: Project administration and coordinating authors could be given a specific mandate for interdisciplinarity. This requires clear definition and understanding of the desired level of disciplinary-integration. Project leadership could also be shared by a wide-range of disciplines to avoid propagating the assumptions, epistemology and methods of one or two disciplines.
5. Interdisciplinary author backgrounds: As recommended by Sanz-Menéndez L. et al. (2001), the presence of a certain number of authors with interdisciplinary backgrounds will aid interdisciplinary practices. This could be achieved by targeting 'interdisciplinary' experts through tendering contract calls.

Table E. Communication forms and relations sustaining expert knowledge transfers

How?	Direct personal contact	Email	Telephone	Inter departmental meetings	Teleconferences	Organised networks	Informal networks of personal contacts	Designated departmental /group liaison	Online database of contacts	Organised conferences	Working groups or expert panels	
	49	6	5	0	2	0	26	11	4	6	11	
Why?	Knowledge of available skills	Lack of external options	Greater trust	Past record of good results	Ease of access	Reputation	Existing formal networks	Previous experience on other projects	Personal informal contacts	Publications	Personal recommendation	Tendered research contract
	9	1	1	5	6	23	28	30	32	30	20	2