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Discussion paper

The Coauthorship Network Analysis of the BI Norwegian Business School

BY

Ivan Belik AND **Kurt Jörnsten**

Norges Handelshøyskole

NORWEGIAN SCHOOL OF ECONOMICS

THE COAUTHORSHIP NETWORK ANALYSIS OF THE BI NORWEGIAN BUSINESS SCHOOL*

Ivan Belik, Kurt Jörnsten

Norwegian School of Economics, Helleveien 30, 5045 Bergen, Norway

Email address: Ivan.Belik@nhh.no, Kurt.Jornsten@nhh.no

Abstract

We construct the coauthorship network based on the scientific collaboration between the faculty members at the Norwegian Business School (BI) and based on their international academic publication experience. The network structure is based on the BI faculties' publications recognized by the ISI Web of Science for the period 1950 – Spring, 2014. The given network covers the publication activities of the BI faculty members (over eight departments) based on the information retrieved from the ISI Web of Science in Spring, 2014. In this paper we analyse the constructed coauthorship network in different aspects of the theory of social networks analysis.

Keywords: coauthorship networks, social networks analysis.

1. INTRODUCTION

Social networks analysis (SNA) is a powerful tool to analyse the interpersonal relations and different types of cooperation between the variety of social groups such as the research or business communities, governmental or private institutions etc. The uniqueness of SNA is its interdisciplinary approach that combines sociology, graph theory, mathematics, psychology etc. (Knoke & Yang, 2008). In contrast to pure network analysis SNA is not concentrated on the structural measurement only, but it takes into consideration the multifactorial social aspects of relations (Carrington, Scott, & Wasserman, 2005).

In this study we build the BI (Norwegian Business School, Oslo) social network based on the coauthorship relations between the faculty members. The resulted BI coauthorship network is constructed based on the information retrieved from *the ISI Web of Science* as of April – May, 2014 (ISI Web of Science, 2014). *ISI Web of Science* provides the online scientific citation indexing service of the highly qualified journals from cross-disciplinary areas. It is important to notice that we use *the ISI Web of Science* as the only source to retrieve the information regarding the BI faculty members' publications in the period 1950 – Spring, 2014. The resulted BI coauthorship network covers eight BI departments:

1. Department of Accounting, Auditing and Law;
2. Department of Communication and Culture;
3. Department of Economics;
4. Department of Finance;
5. Department of Innovation and Economic Organisation;
6. Department of Leadership and Organizational Behaviour;
7. Department of Marketing;
8. Department of Strategy and Logistics.

* Textual description is based on Belik, I., & Jornsten, K. (2014)

The coauthorship network's nodes correspond to the faculty members, and the links (i.e., edges) between them correspond to the existence of common publications. Every edge has a weight, which is the number of joint publications. We consider not only the internal departmental and interdepartmental relations between the faculty members, but also we show the external publications with authors that are not affiliated with BI. These "external" coauthors are grouped into the country-nodes. For example, if "external" author A and "external" author B specify their affiliation with country N in their publications then both A and B are grouped into one node N. As the result, we show the research cooperation of the BI faculty members on the international level.

In section 2 we show the position of each faculty member within the BI coauthorship network including the internal departmental, interdepartmental and external coauthorship relations. Also, we provide the number of publications, which are done by each faculty member. The results are represented in tabular and graphical formats.

Section 3 is devoted to the analysis of coauthorship cliques between the faculty members. Since cliques (Hanneman & Riddle, 2005) correspond to the groups of faculty members that have strong coauthorship relations, we analyze the BI coauthorship network to detect such groups (i.e., cliques) on the departmental and interdepartmental levels.

In section 4 we analyze the BI coauthorship network based on the spanning trees' detection (West, 2001). Spanning tree's analysis is the way to understand the spread of the research interests over the whole BI coauthorship network. Moreover, due to the fact that the BI coauthorship network is represented by the disconnected graph, we analyze it in terms of the interdepartmental spanning forest (Bollobás, 1998).

In section 5 we analyze the international coauthorship. The analysis is based on the investigation of how many persons (i.e., nodes) at BI coauthorship network should be deleted in order for the international coauthorship to be vanishing.

The overall publications-based analysis is represented in section 6. Specifically, we analyze the contribution of the most published faculty members to the overall BI research activity.

2. PERSONAL INTERNAL, EXTERNAL AND OVERALL COAUTHORSHIPS

For each faculty member we analyse the number of departmental, interdepartmental, and external (i.e., not affiliated with BI) collaborations and the number of the published papers based on *the ISI Web of Science*. We provide the details for each department in tabular and graph-based formats.

In Tables 1-9 and in Figures 1-25 we provide the information regarding the internal, interdepartmental and external coauthorship for each faculty member. The values given in Tables 1-9 correspond to the number of coauthors and to the number of publications for each faculty member. In Figures 1, 4, 7, 10, 13, 16, 19 and 22 we provide the information regarding the number of coauthors versus the number of publications for each faculty member.

The networks of the internal (i.e., departmental) coauthorship are represented in Figures 2, 5, 8, 11, 14, 17, 20 and 23 for each department. The overall departmental networks that include the internal, interdepartmental and external coauthorship are represented in Figures 3, 6, 9, 12, 15, 18, 21 and 24.

2.1 Department of Accounting, Auditing and Law

Table 1. Coauthorship and the number of publications by persons

Faculty	Coauthorship				Number of publications		Faculty	Coauthorship				Number of publications
	Internal	Interdepart.	external	Total				Internal	Interdepart.	external	Total	
node 1	0	0	0	0	0		node 27	0	0	2	2	4
node 2	0	0	0	0	0		node 28	0	0	0	0	0
node 3	0	0	0	0	0		node 29	0	0	3	3	2
node 4	0	0	0	0	0		node 30	0	0	0	0	0
node 5	0	0	0	0	0		node 31	0	0	0	0	0
node 6	0	0	0	0	0		node 32	0	0	0	0	0
node 7	0	0	0	0	0		node 33	0	0	0	0	0
node 8	0	0	0	0	0		node 34	0	0	0	0	0
node 9	0	0	0	0	0		node 35	0	0	0	0	0
node 10	0	0	3	3	1		node 36	0	0	23	23	13
node 11	1	2	4	7	7		node 37	0	0	10	10	2
node 12	0	0	0	0	0		node 38	0	0	27	27	12
node 13	0	0	0	0	0		node 39	0	1	0	1	1
node 14	0	0	0	0	0		node 40	0	0	0	0	1
node 15	0	0	0	0	0		node 41	0	0	0	0	0
node 16	0	0	0	0	0		node 42	0	0	1	1	1
node 17	0	0	0	0	0		node 43	1	0	10	11	20
node 18	0	0	0	0	0		node 44	0	0	0	0	0
node 19	0	0	0	0	1		node 45	0	0	0	0	0
node 20	0	0	0	0	0		node 46	0	0	0	0	0
node 21	0	0	0	0	0		node 47	0	0	0	0	0
node 22	0	0	0	0	0		node 48	0	0	0	0	0
node 23	0	0	0	0	0		node 49	0	0	0	0	0
node 24	0	0	0	0	0		node 50	0	0	0	0	0
node 25	0	0	0	0	0		node 51	0	0	0	0	0
node 26	0	0	0	0	0		node 52	0	0	0	0	0

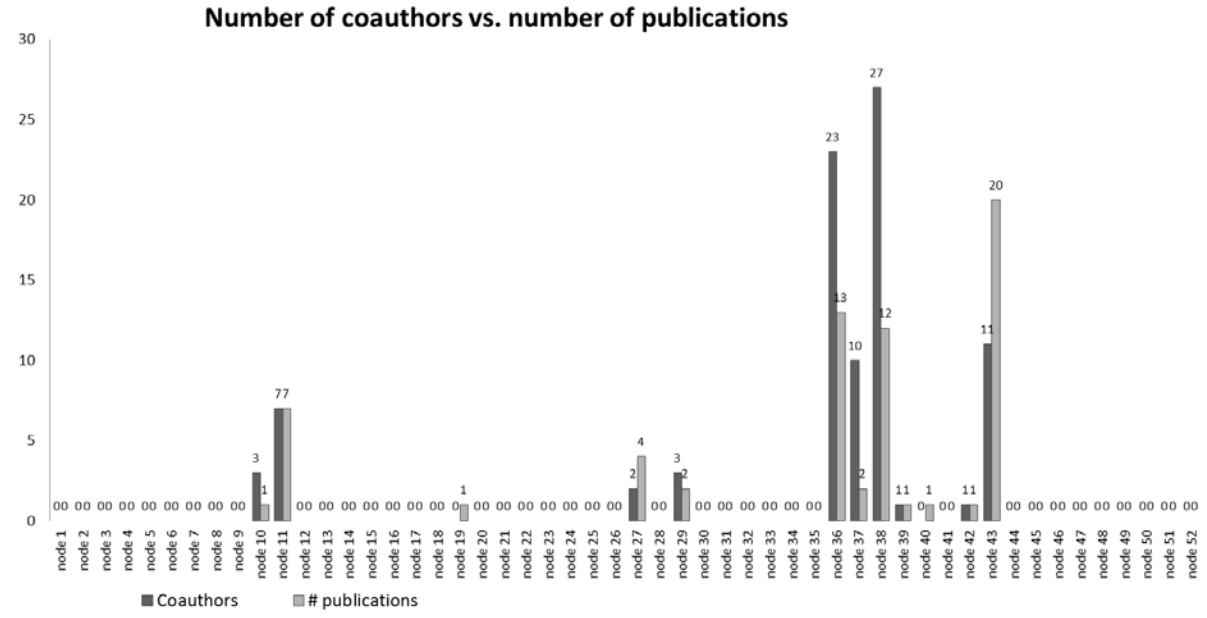

Figure 1. Department of Accounting, Auditing and Law:
Number of coauthors vs. number of publications

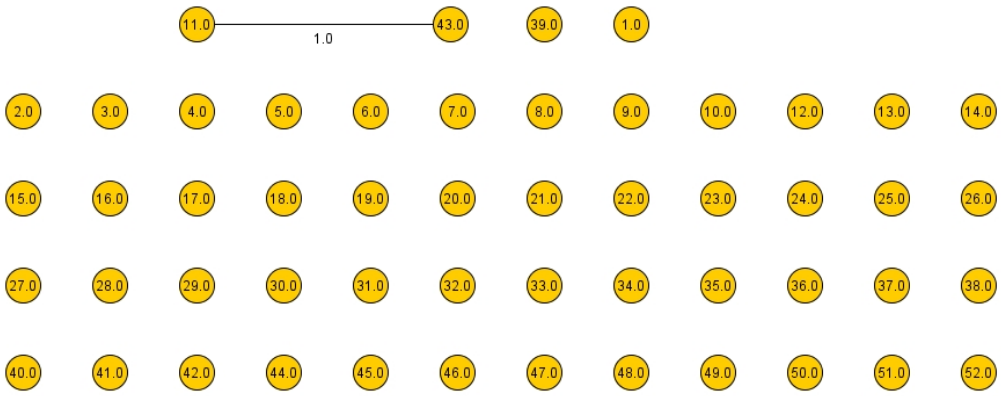

Figure 2. Department of Accounting, Auditing and Law – the internal coauthorship network

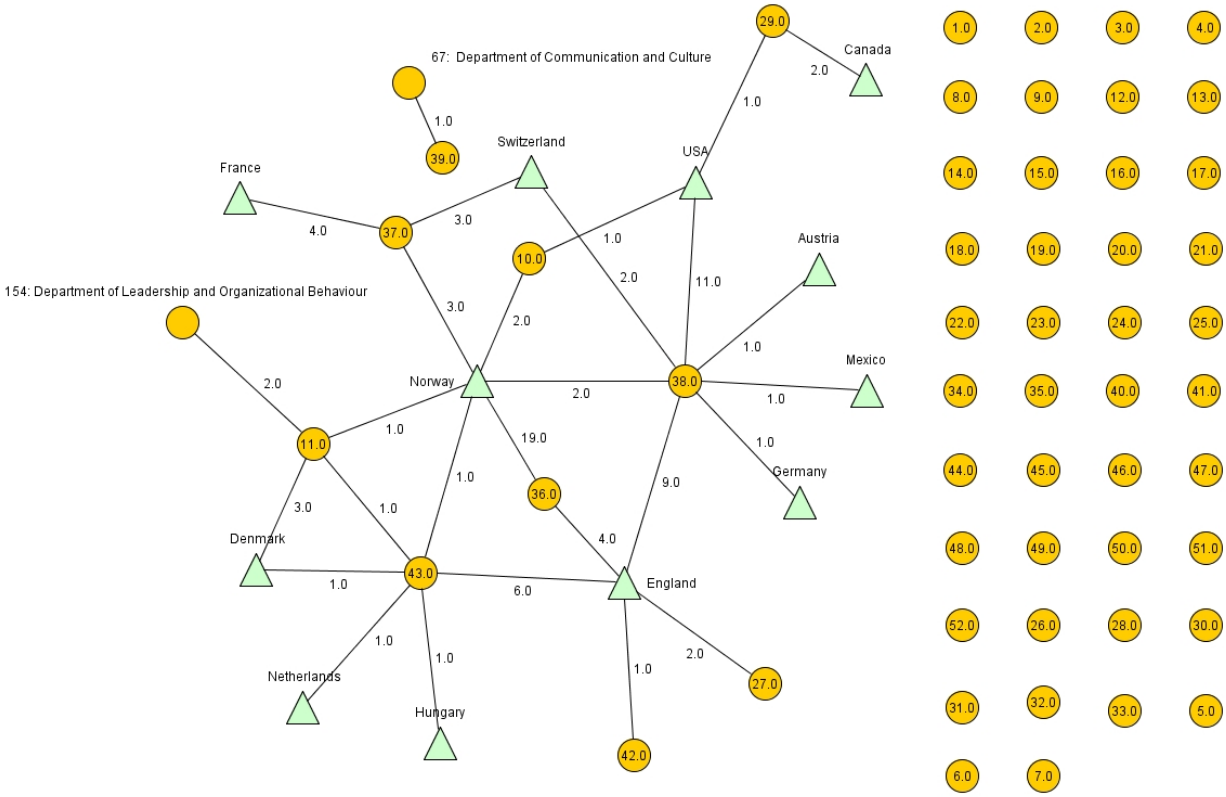

Figure 3. Department of Accounting, Auditing and Law – the overall coauthorship network

2.2 Department of Communication and Culture

Table 2. Coauthorship and the number of publications by persons

Faculty	Coauthorship				Number of publications		Faculty	Coauthorship				Number of publications
	Internal	Interdepart.	external	Total				Internal	Interdepart.	external	Total	
node 53	0	0	0	0	1		node 65	0	0	0	0	0
node 54	0	0	0	0	0		node 66	0	3	4	7	5
node 55	0	0	0	0	0		node 67	0	1	47	48	28
node 56	0	2	6	8	6		node 68	0	0	0	0	0
node 57	0	0	0	0	3		node 69	0	0	0	0	0
node 58	0	0	0	0	0		node 70	0	0	0	0	0
node 59	0	0	8	8	6		node 71	0	0	0	0	0
node 60	0	0	0	0	0		node 72	0	0	4	4	2
node 61	0	0	0	0	1		node 73	0	0	2	2	3
node 62	0	0	0	0	2		node 74	0	0	0	0	0
node 63	0	0	0	0	0		node 75	0	0	0	0	0
node 64	0	0	0	0	0		node 76	0	0	0	0	0

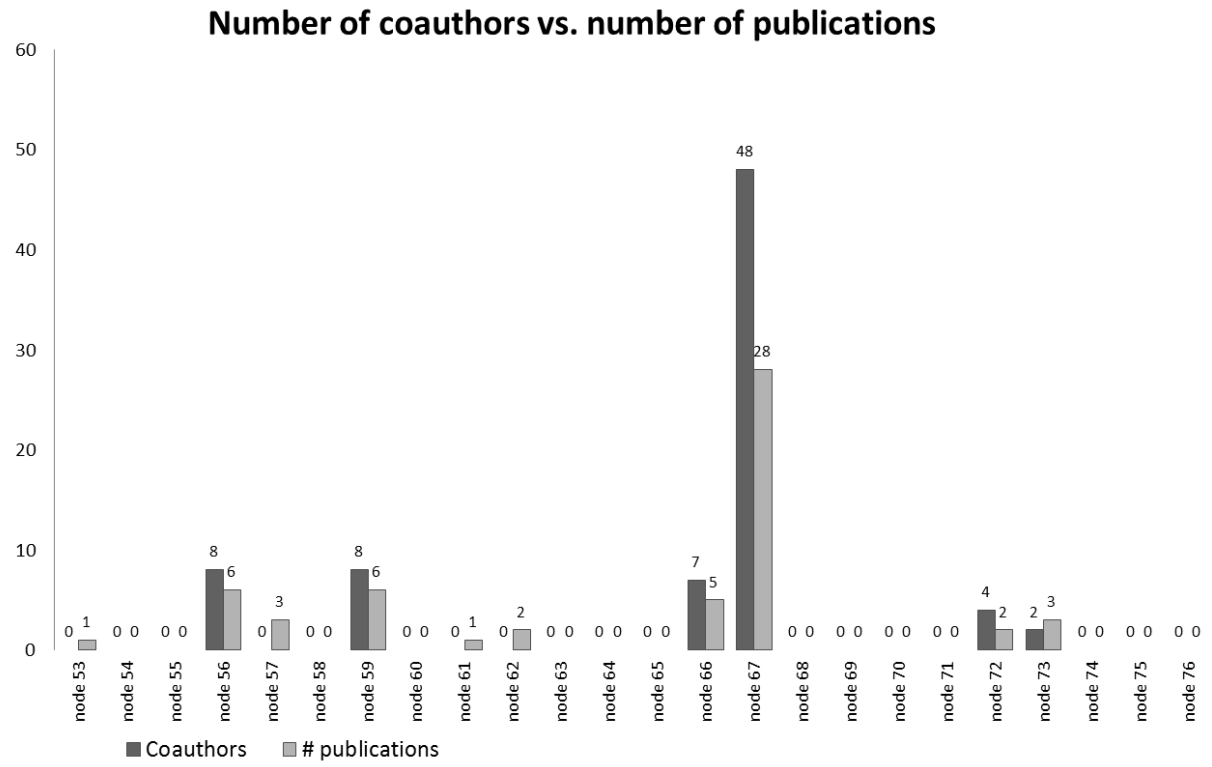

Figure 4. Department of Communication and Culture:
number of coauthors vs. number of publications

Figure 5. Department of Communication and Culture – the internal coauthorship network

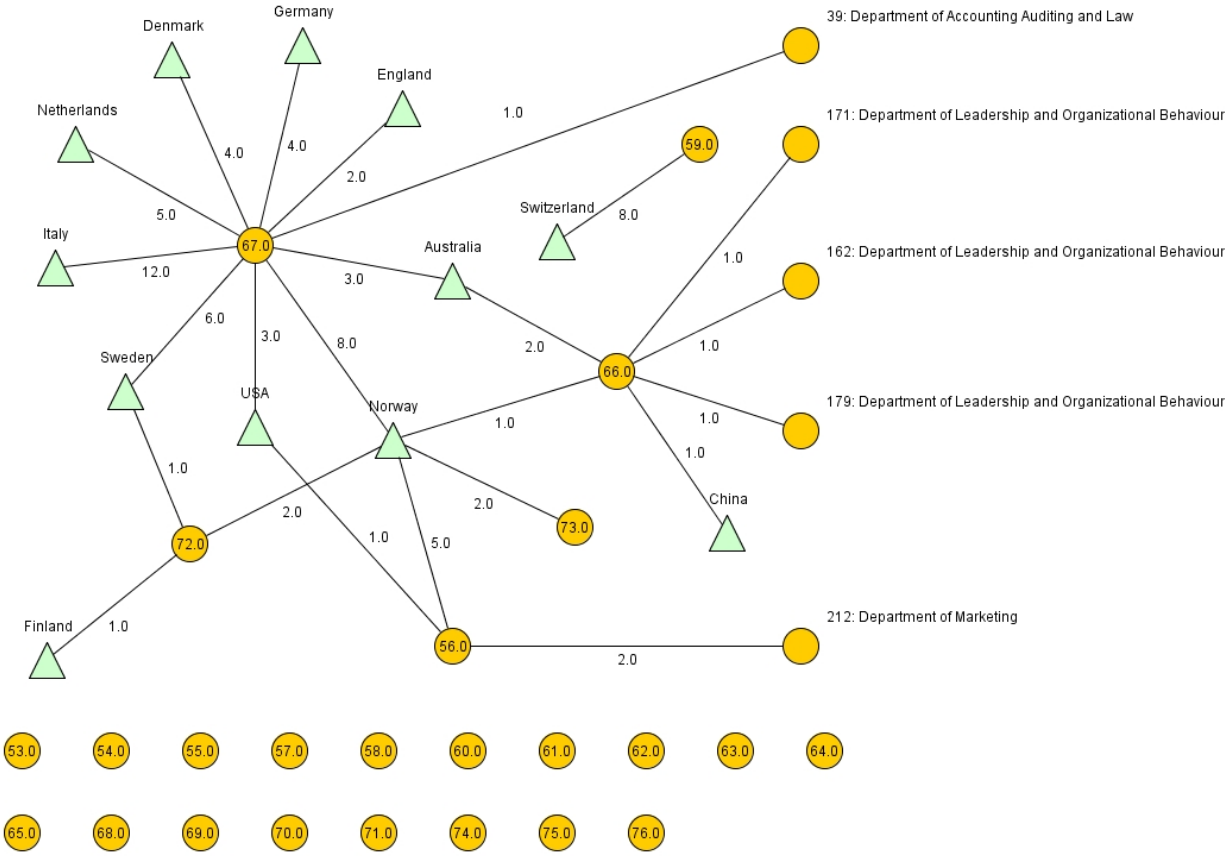

Figure 6. Department of Communication and Culture – the overall coauthorship network

2.3 Department of Economics

Table 3. Coauthorship and the number of publications by persons

Faculty	Coauthorship				Number of publications		Faculty	Coauthorship				Number of publications
	Internal	Interdepart.	external	Total				Internal	Interdepart.	external	Total	
node 77	1	0	3	4	7		node 92	0	0	0	0	0
node 78	0	2	15	17	18		node 93	0	0	3	3	9
node 79	0	0	38	38	8		node 94	2	0	26	28	20
node 80	0	0	0	0	0		node 95	0	0	0	0	0
node 81	0	0	21	21	10		node 96	2	0	20	22	15
node 82	1	0	6	7	8		node 97	0	0	0	0	0
node 83	0	0	44	44	38		node 98	0	0	4	4	2
node 84	0	0	0	0	0		node 99	0	0	14	14	10
node 85	0	0	1	1	1		node 100	3	0	45	48	42
node 86	0	0	0	0	0		node 101	0	0	8	8	14
node 87	1	0	4	5	4		node 102	0	0	4	4	6
node 88	4	0	7	11	9		node 103	0	0	12	12	10
node 89	0	0	0	0	10		node 104	0	0	1	1	1
node 90	0	0	0	0	0		node 105	0	0	0	0	1
node 91	0	0	0	0	0							

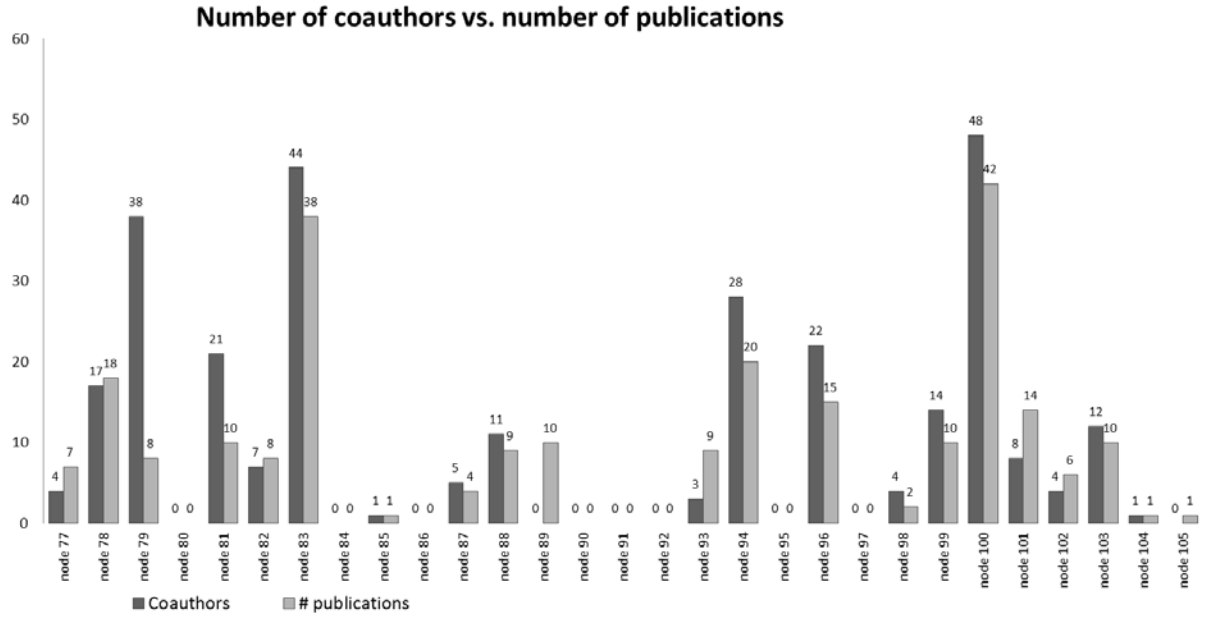

Figure 7. Department of Economics:
number of coauthors vs. number of publications

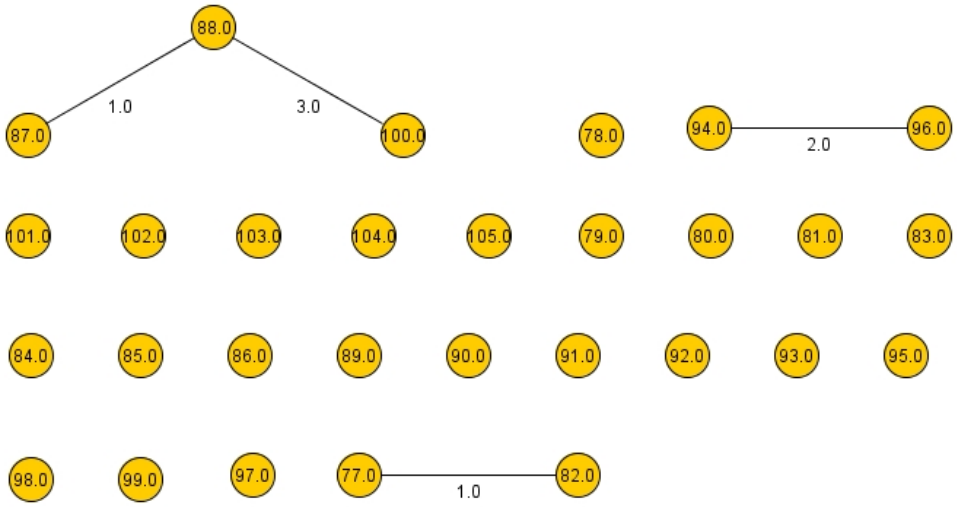

Figure 8. Department of Economics – the internal coauthorship network

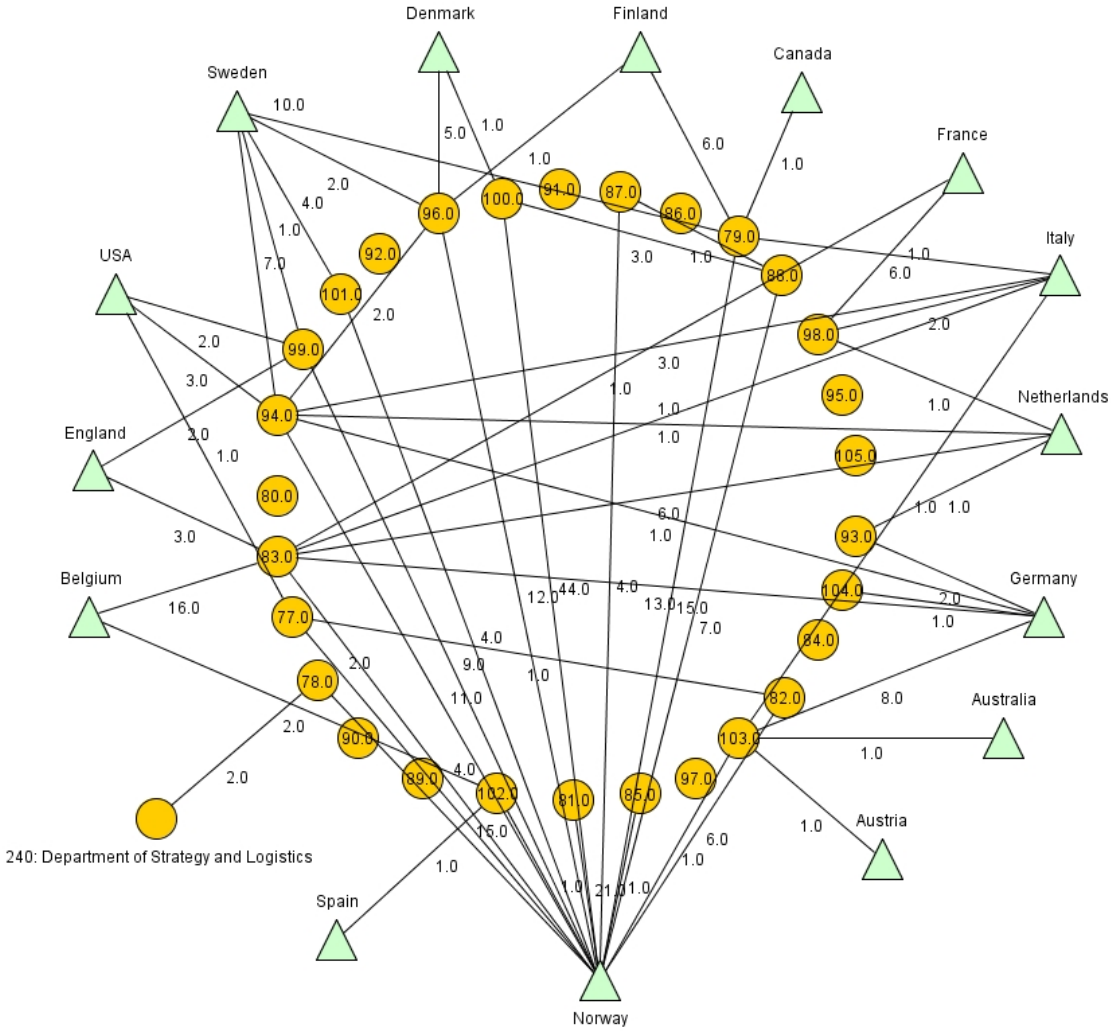

Figure 9. Department of Economics – the overall coauthorship network

2.4 Department of Finance

Table 4. Coauthorship and the number of publications by persons

Faculty	Coauthorship				Number of publications		Faculty	Coauthorship				Number of publications
	Internal	Interdepart.	external	Total				Internal	Interdepart.	external	Total	
node 106	0	0	2	2	1		node 118	0	0	7	7	5
node 107	3	0	3	6	3		node 119	0	0	5	5	3
node 108	0	0	13	13	12		node 120	3	0	26	29	22
node 109	0	0	0	0	1		node 121	0	0	0	0	0
node 110	0	0	0	0	0		node 122	3	0	18	21	10
node 111	3	0	0	3	4		node 123	0	0	0	0	0
node 112	0	0	1	1	1		node 124	0	0	0	0	0
node 113	0	0	8	8	5		node 125	0	0	0	0	0
node 114	0	0	0	0	0		node 126	0	0	0	0	0
node 115	0	0	0	0	0		node 127	0	0	3	3	2
node 116	0	0	0	0	0		node 128	0	0	0	0	1
node 117	0	0	0	0	0		node 129	0	0	2	2	1

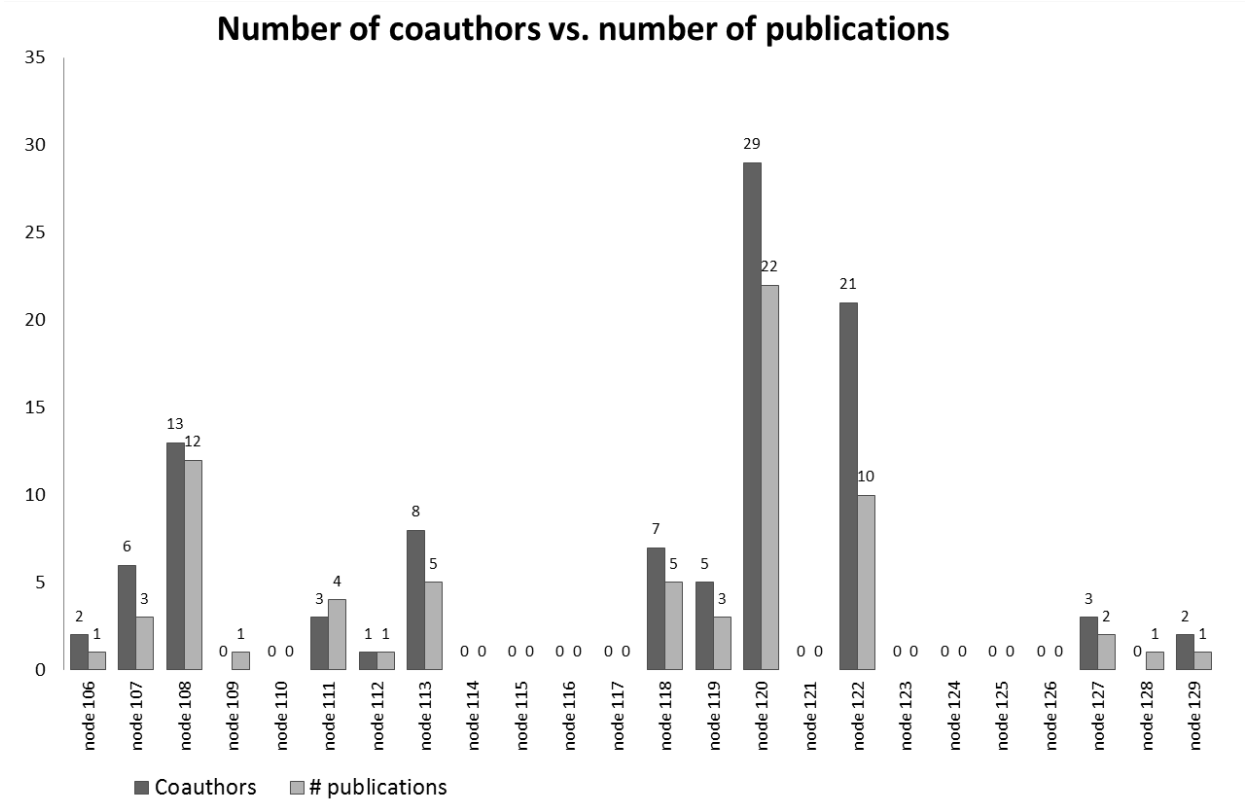

Figure 10. Department of Finance:
number of coauthors vs. number of publications

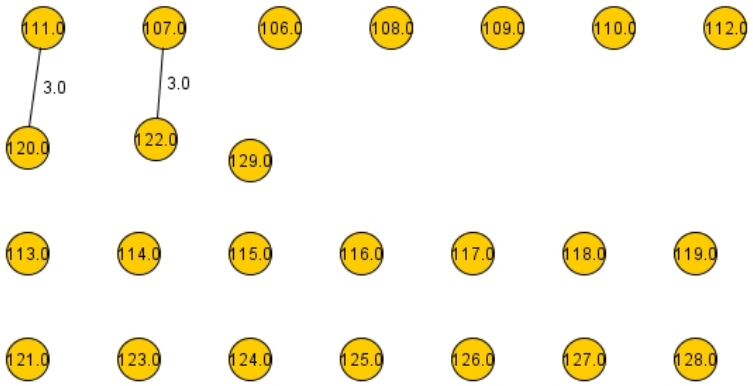

Figure 11. Department of Finance – the internal coauthorship network

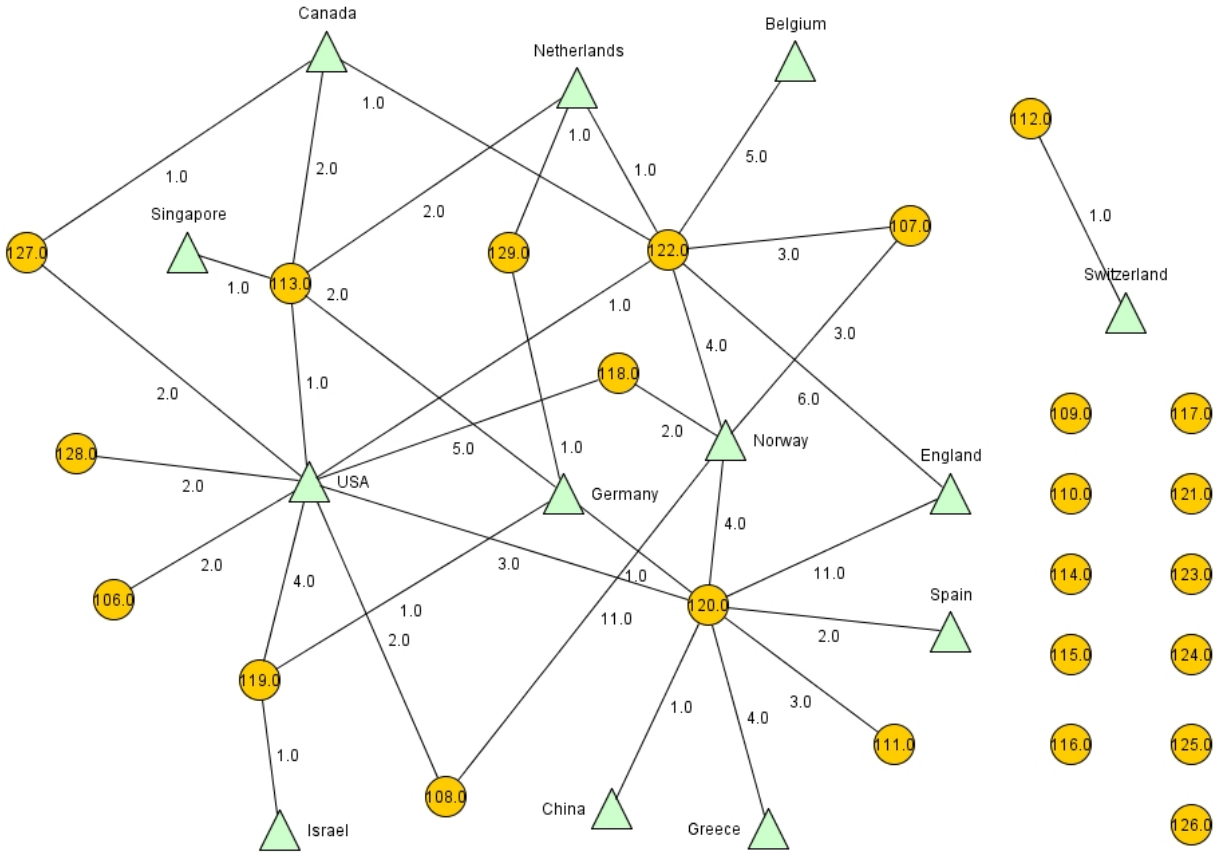

Figure 12. Department of Finance – the overall coauthorship network

2.5 Department of Innovation and Economic Organisation

Table 5. Coauthorship and the number of publications by persons

Faculty	Coauthorship				Number of publications		Faculty	Coauthorship				Number of publications
	Internal	Interdepart.	external	Total				Internal	Interdepart.	external	Total	
node 130	0	0	10	10	8		node 142	0	0	0	0	3
node 131	0	0	3	3	21		node 143	0	0	0	0	0
node 132	0	0	8	8	8		node 144	0	0	1	1	1
node 133	0	0	2	2	2		node 145	0	0	5	5	4
node 134	0	0	0	0	0		node 146	0	0	0	0	0
node 135	0	0	0	0	0		node 147	0	0	0	0	0
node 136	0	0	0	0	1		node 148	0	2	19	21	23
node 137	0	0	0	0	0		node 149	1	0	0	1	1
node 138	0	2	32	34	28		node 150	0	0	0	0	0
node 139	0	0	0	0	0		node 151	0	0	0	0	0
node 140	1	0	8	9	4		node 152	0	0	0	0	3
node 141	0	0	5	5	5		node 153	0	0	0	0	0

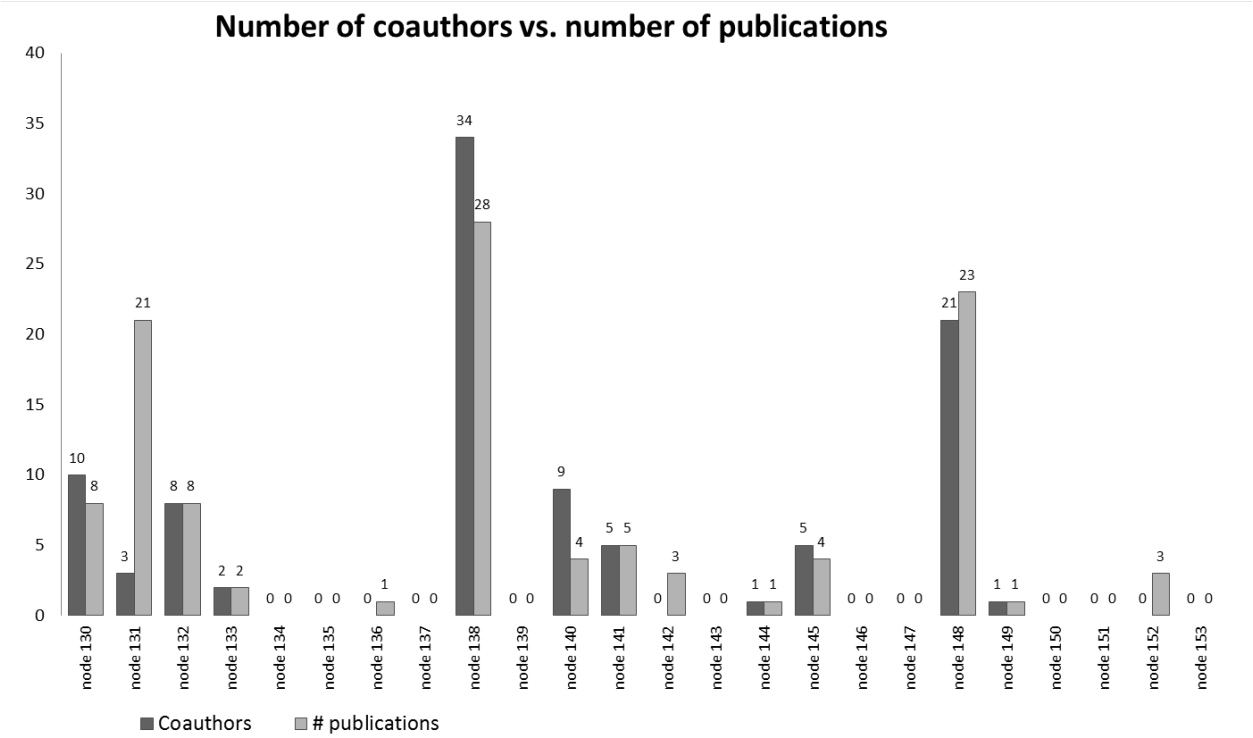

Figure 13. Department of Innovation and Economic Organisation: number of coauthors vs. number of publications

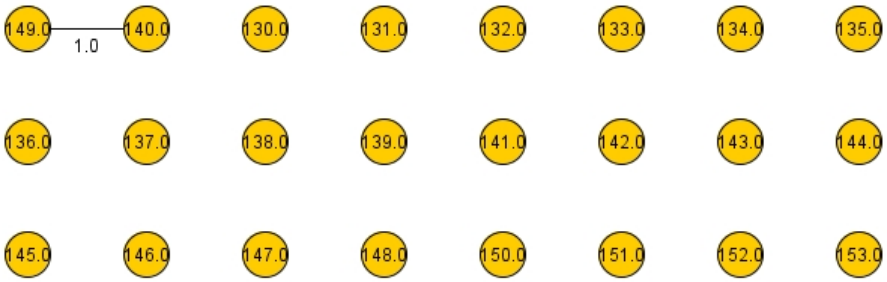

Figure 14. Department of Innovation and Economic Organisation – the internal coauthorship network

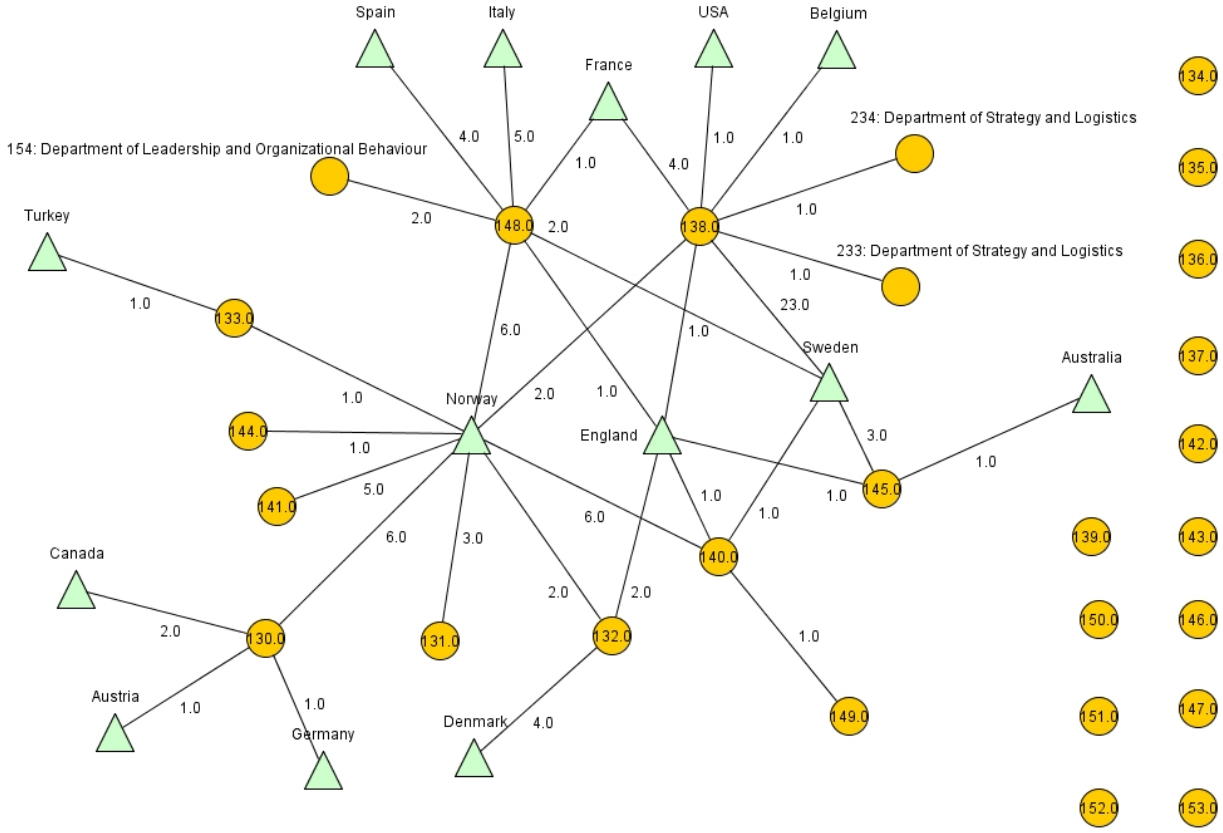

Figure 15. Department of Innovation and Economic Organisation – the overall coauthorship network

2.6 Department of Leadership and Organizational Behaviour

Table 6. Coauthorship and the number of publications by persons

Faculty	Coauthorship				Number of publications		Faculty	Coauthorship				Number of publications
	Internal	Interdepart.	external	Total				Internal	Interdepart.	external	Total	
node 154	0	4	7	11	15		node 173	0	0	2	2	4
node 155	2	0	8	10	6		node 174	1	0	21	22	14
node 156	0	0	0	0	0		node 175	2	3	12	17	5
node 157	2	0	0	2	2		node 176	1	0	5	6	7
node 158	0	0	0	0	2		node 177	0	0	0	0	0
node 159	0	0	2	2	0		node 178	1	0	25	26	9
node 160	0	0	0	0	0		node 179	5	1	3	9	4
node 161	0	0	0	0	0		node 180	1	1	31	33	27
node 162	20	1	6	27	18		node 181	3	0	52	55	25
node 163	4	0	4	8	5		node 182	1	0	16	17	8
node 164	0	0	2	2	2		node 183	0	0	0	0	0
node 165	0	0	36	36	13		node 184	2	0	66	68	29
node 166	6	0	18	24	70		node 185	0	0	37	37	38
node 167	4	0	16	20	10		node 186	0	0	1	1	1
node 168	2	2	3	7	6		node 187	3	3	1	7	4
node 169	4	0	8	12	10		node 188	0	0	1	1	2
node 170	0	2	1	3	3		node 189	0	0	19	19	9
node 171	17	1	12	30	28		node 190	0	0	6	6	4
node 172	1	0	7	8	3		node 191	0	0	0	0	0

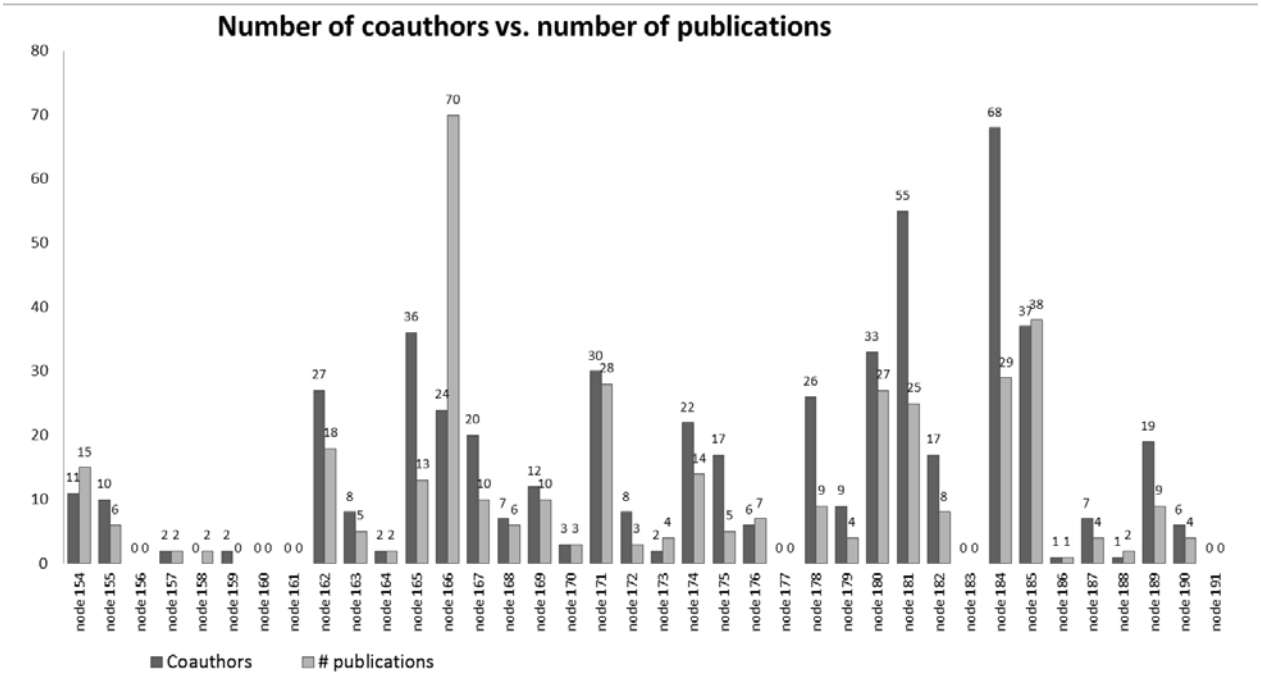

Figure 16. Department of Leadership and Organizational Behaviour: number of coauthors vs. number of publications

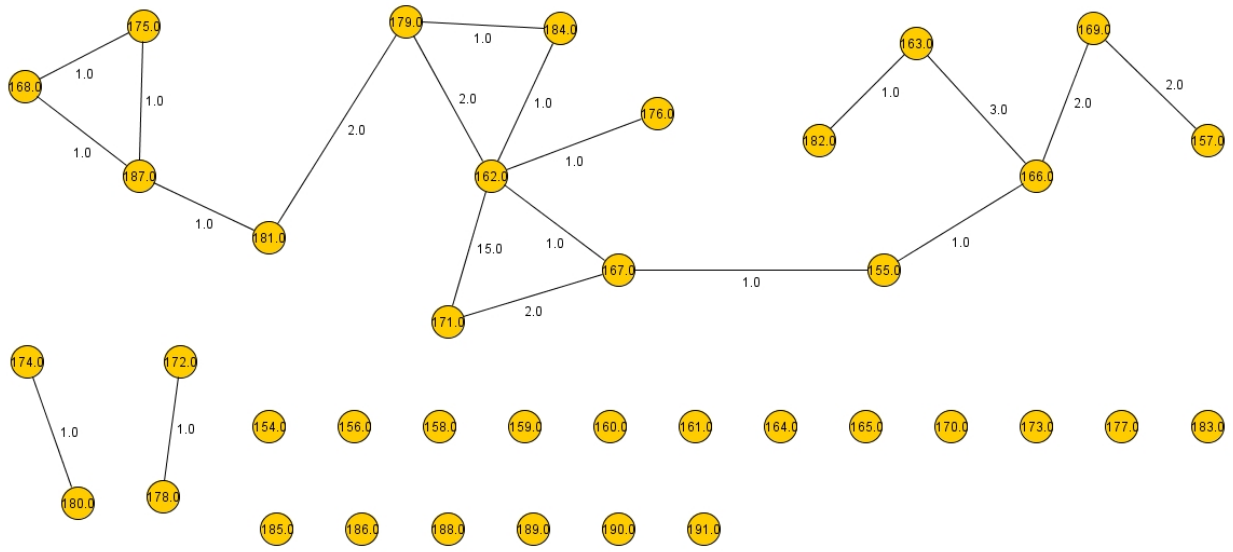

Figure 17. Department of Leadership and Organizational Behaviour – the internal coauthorship network

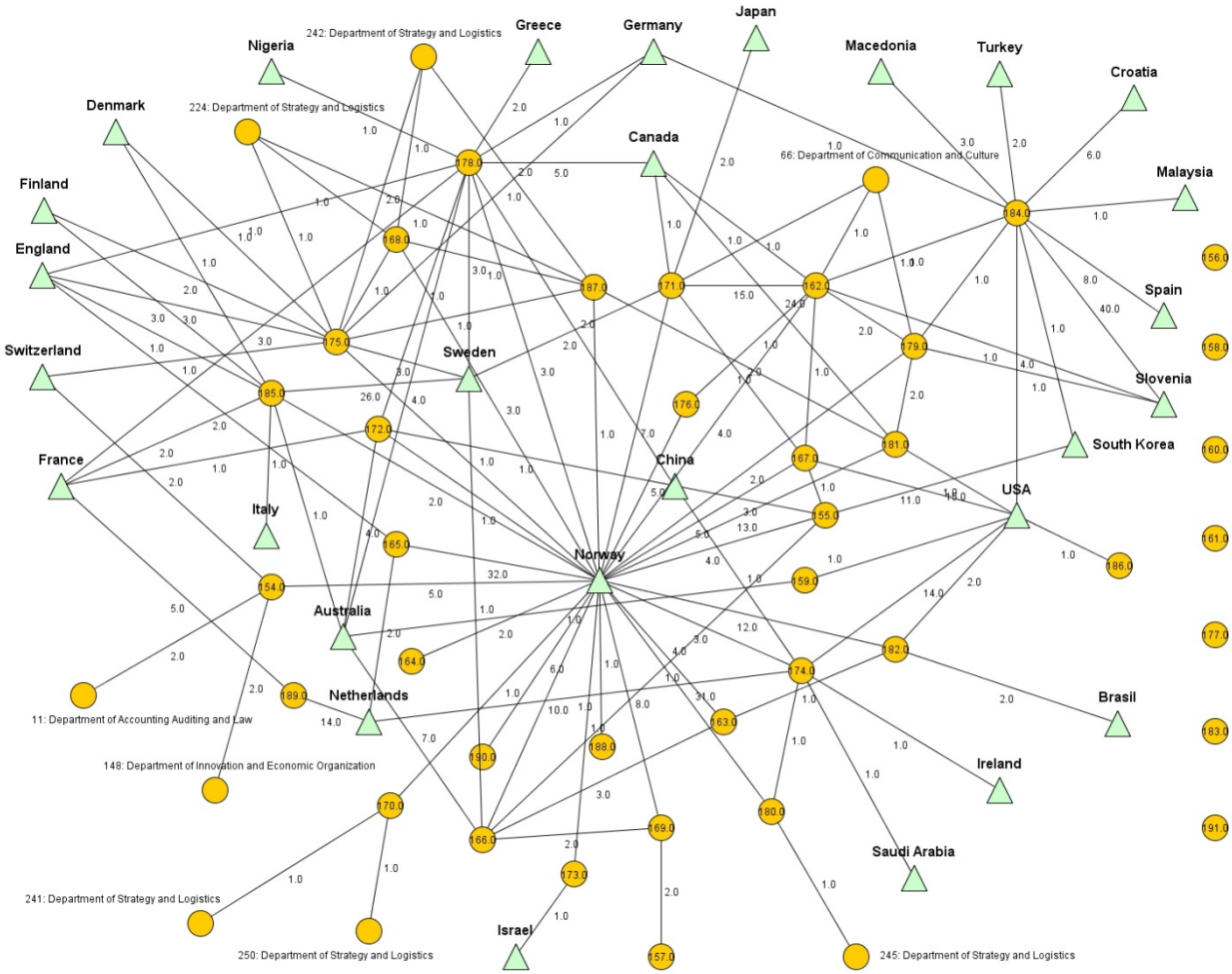

Figure 18. Department of Leadership and Organizational Behaviour – the overall coauthorship network

2.7 Department of Marketing

Table 7. Coauthorship and the number of publications by persons

Faculty	Coauthorship				Number of publications		Faculty	Coauthorship				Number of publications
	Internal	Interdepart.	external	Total				Internal	Interdepart.	external	Total	
node 192	7	0	43	50	18		node 208	0	0	0	0	0
node 193	0	0	0	0	0		node 209	2	0	2	4	2
node 194	0	0	9	9	3		node 210	3	0	6	9	4
node 195	0	0	0	0	0		node 211	0	0	10	10	7
node 196	0	0	0	0	0		node 212	0	2	15	17	19
node 197	0	0	0	0	0		node 213	0	0	0	0	0
node 198	2	0	9	11	10		node 214	0	0	0	0	0
node 199	0	0	0	0	0		node 215	3	0	10	13	7
node 200	0	0	7	7	10		node 216	0	0	2	2	1
node 201	0	0	3	3	2		node 217	2	0	6	8	6
node 202	0	0	0	0	0		node 218	1	0	4	5	2
node 203	0	0	5	5	2		node 219	1	0	4	5	5
node 204	0	0	0	0	0		node 220	3	0	13	16	16
node 205	0	0	0	0	0		node 221	0	0	0	0	0
node 206	2	0	3	5	5		node 222	0	0	1	1	1
node 207	4	0	5	9	4		node 223	0	0	127	127	59

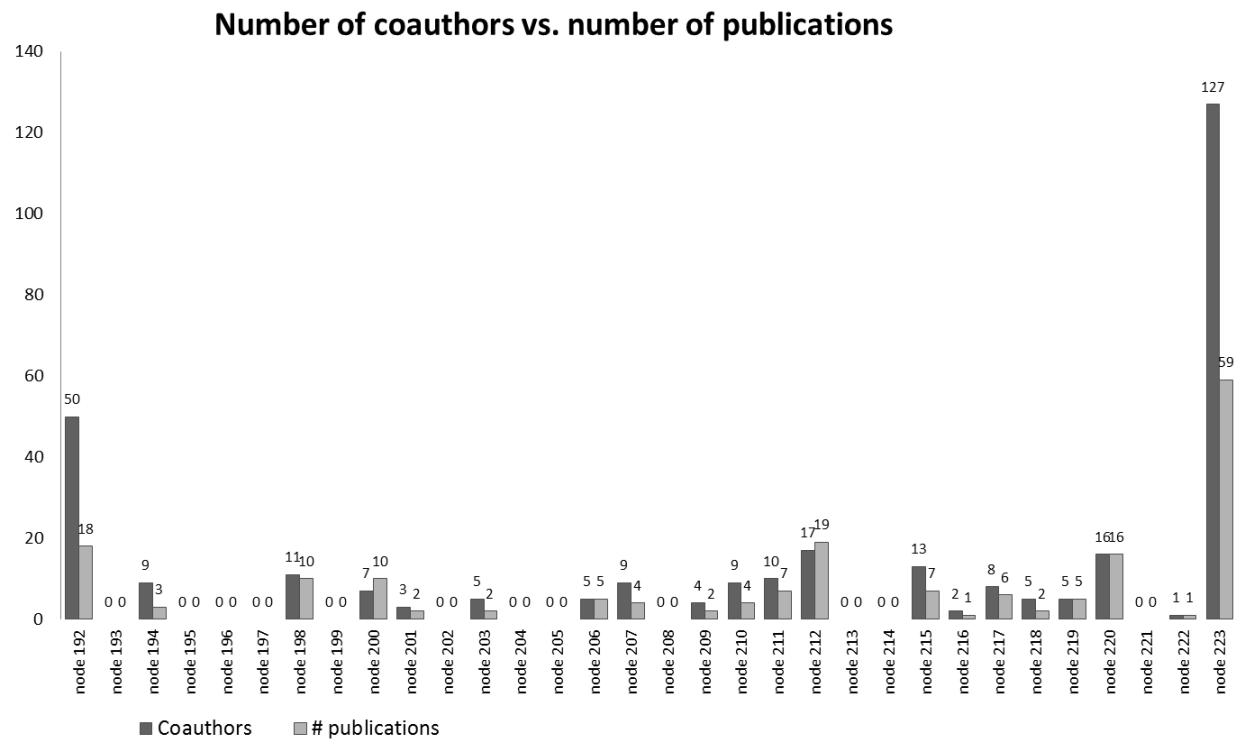

Figure 19. Department of Marketing: number of coauthors vs. number of publications

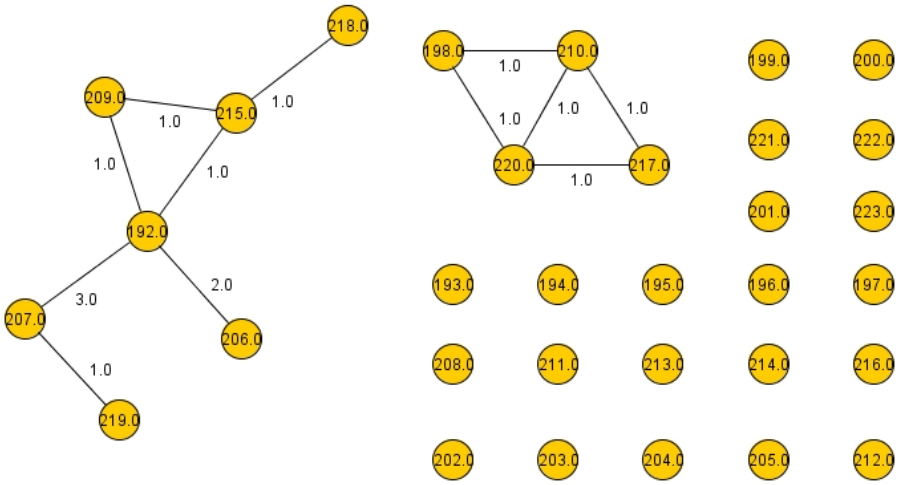

Figure 20. Department of Marketing – the internal coauthorship network

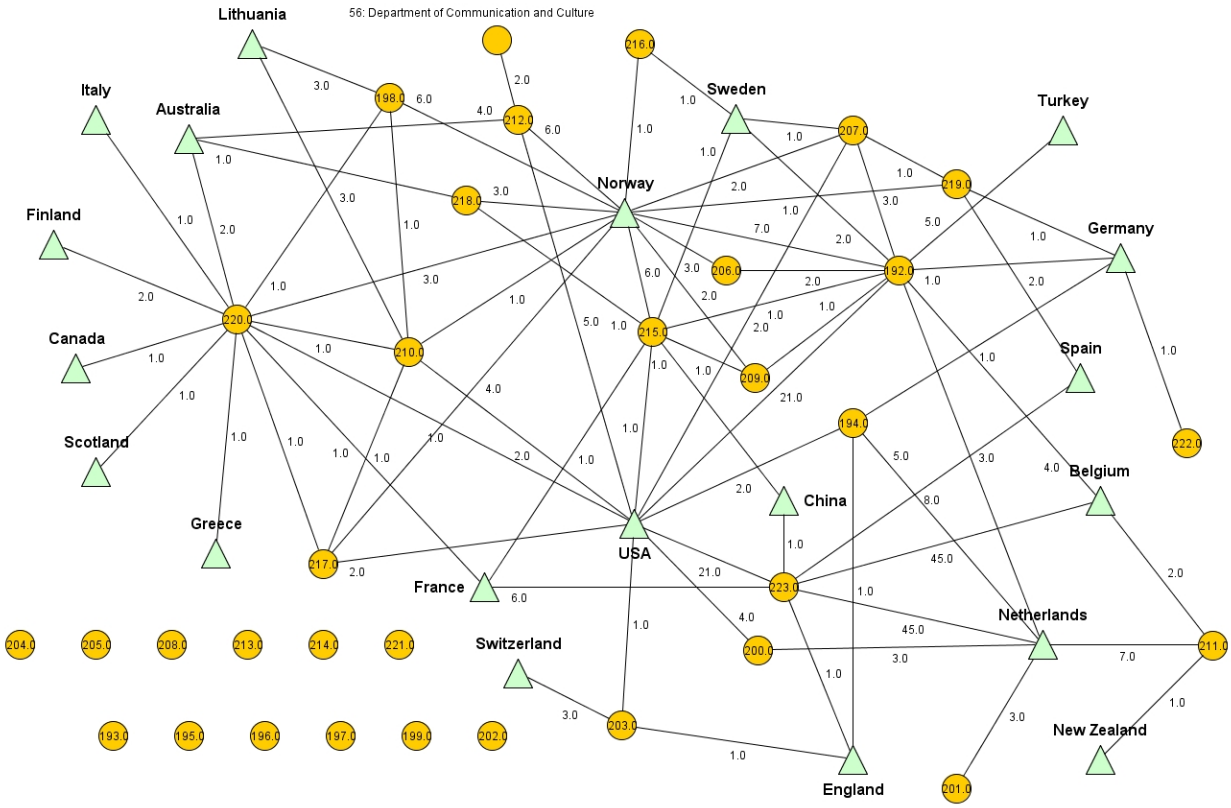

Figure 21. Department of Marketing – the overall coauthorship network

2.8 Department of Strategy and Logistics

Table 8. Coauthorship and the number of publications by persons

Faculty	Coauthorship				Number of publications		Faculty	Coauthorship				Number of publications
	Internal	Interdepart.	external	Total				Internal	Interdepart.	external	Total	
node 224	2	3	9	14	11		node 239	1	0	4	5	4
node 225	0	0	0	0	0		node 240	0	2	11	13	10
node 226	1	0	0	1	1		node 241	5	1	5	11	8
node 227	1	0	3	4	3		node 242	8	5	11	24	14
node 228	0	0	13	13	19		node 243	1	0	24	25	4
node 229	4	0	6	10	4		node 244	1	0	3	4	2
node 230	1	0	0	1	1		node 245	4	1	2	7	5
node 231	5	0	21	26	12		node 246	0	0	15	15	13
node 232	0	0	2	2	1		node 247	3	0	5	8	6
node 233	0	1	13	14	12		node 248	3	0	0	3	2
node 234	2	1	6	9	11		node 249	3	0	7	10	6
node 235	3	0	3	6	4		node 250	0	1	5	6	8
node 236	0	0	0	0	0		node 251	0	0	0	0	0
node 237	0	0	6	6	5		node 252	0	0	8	8	1
node 238	0	0	29	29	14							

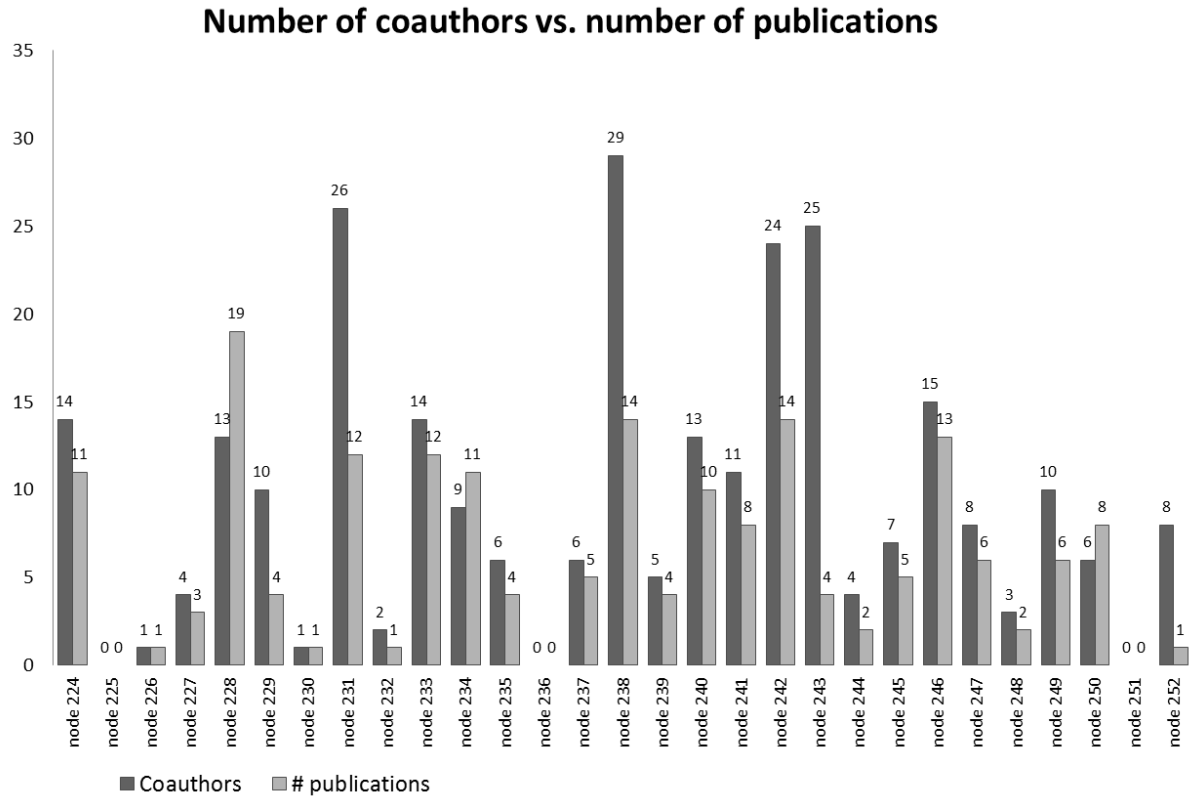

Figure 22. Department of Strategy and Logistics: number of coauthors vs. number of publications

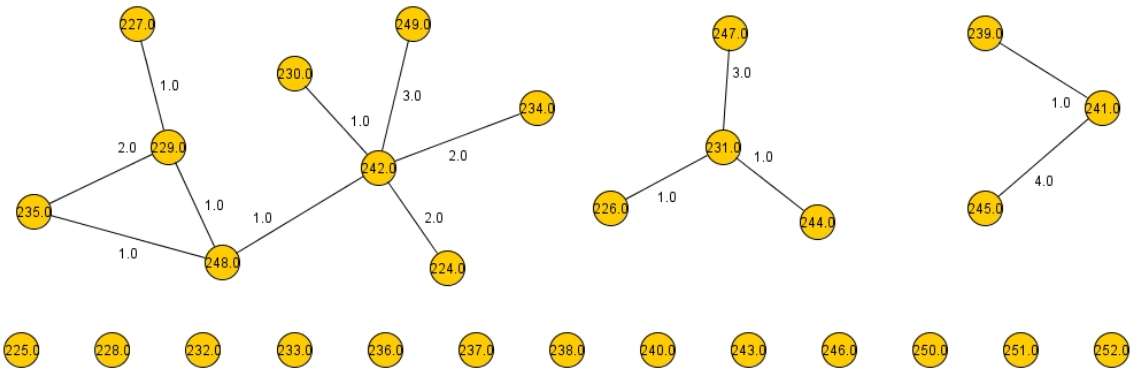

Figure 23. Department of Strategy and Logistics – the internal coauthorship network

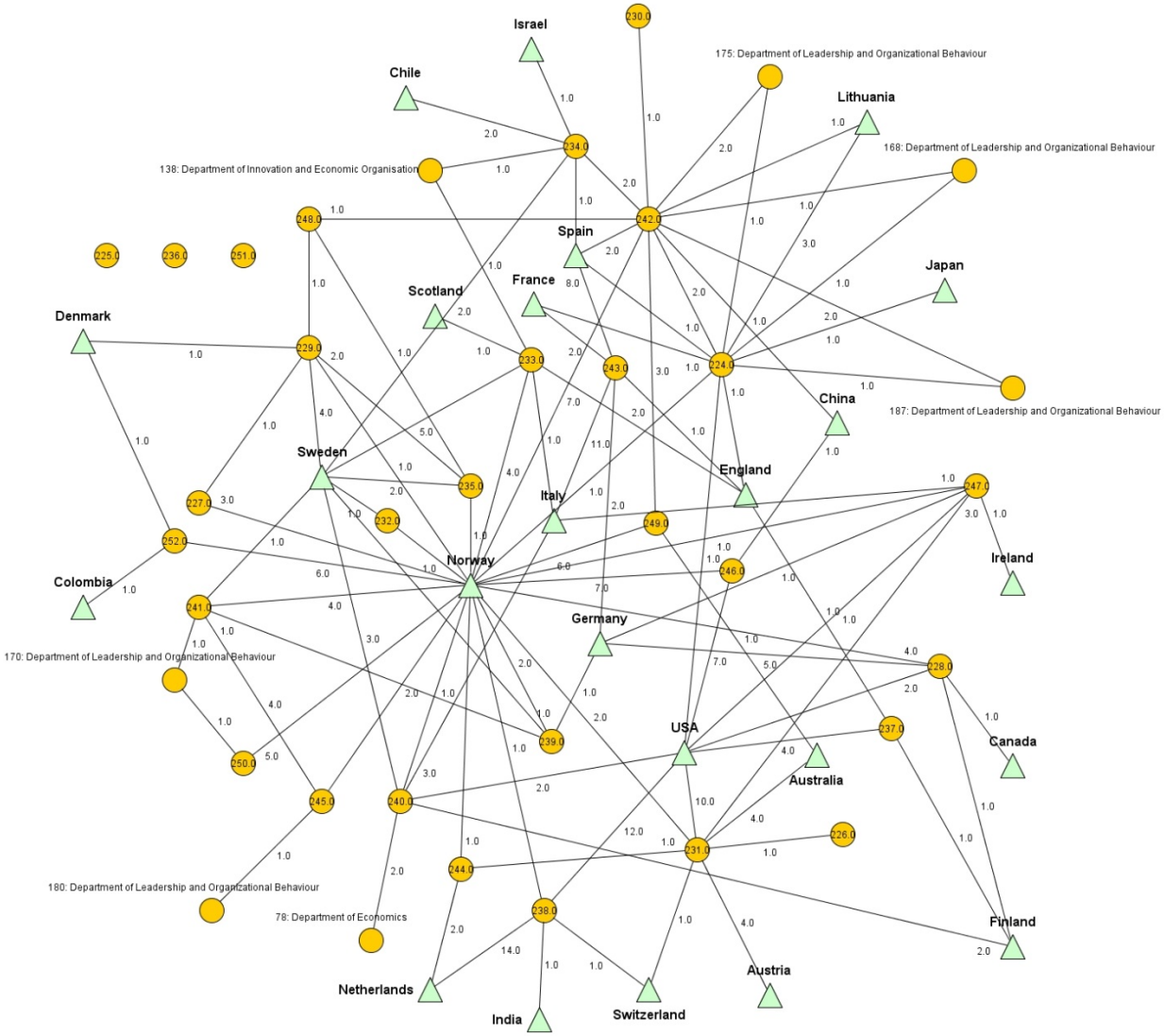

Figure 24. Department of Strategy and Logistics – the overall coauthorship network

2.9 The interdepartmental coauthorship network

There are 27 BI faculty member that are involved in the interdepartmental collaboration: nine – from the Department of Leadership and Organizational Behaviour; eight – from the Department of Strategy and Logistics; three – from the Department of Communication and Culture; three – from the Department of Innovation and Economic Organisation; one – from the Department of Economics, and one – from the Department of Marketing (see Table 9).

Table 9. Faculty members with interdepartmental coauthorship

Department of Leadership and Organizational Behaviour		Department of Strategy and Logistics		Department of Communication and Culture		Department of Accounting, Auditing and Law		Department of Innovation and Economic Organisation		Department of Economics		Department of Marketing	
1	node 154	1	node 224	1	node 56	1	node 11	1	node 138	1	node 78	1	node 212
2	node 162	2	node 233	2	node 66	2	node 39	2	node 148				
3	node 168	3	node 234	3	node 67	3	node 43						
4	node 170	4	node 240										
5	node 171	5	node 241										
6	node 175	6	node 242										
7	node 179	7	node 245										
8	node 180	8	node 250										
9	node 187												

The detailed representation of the interdepartmental coauthorship is represented in Figure 25.

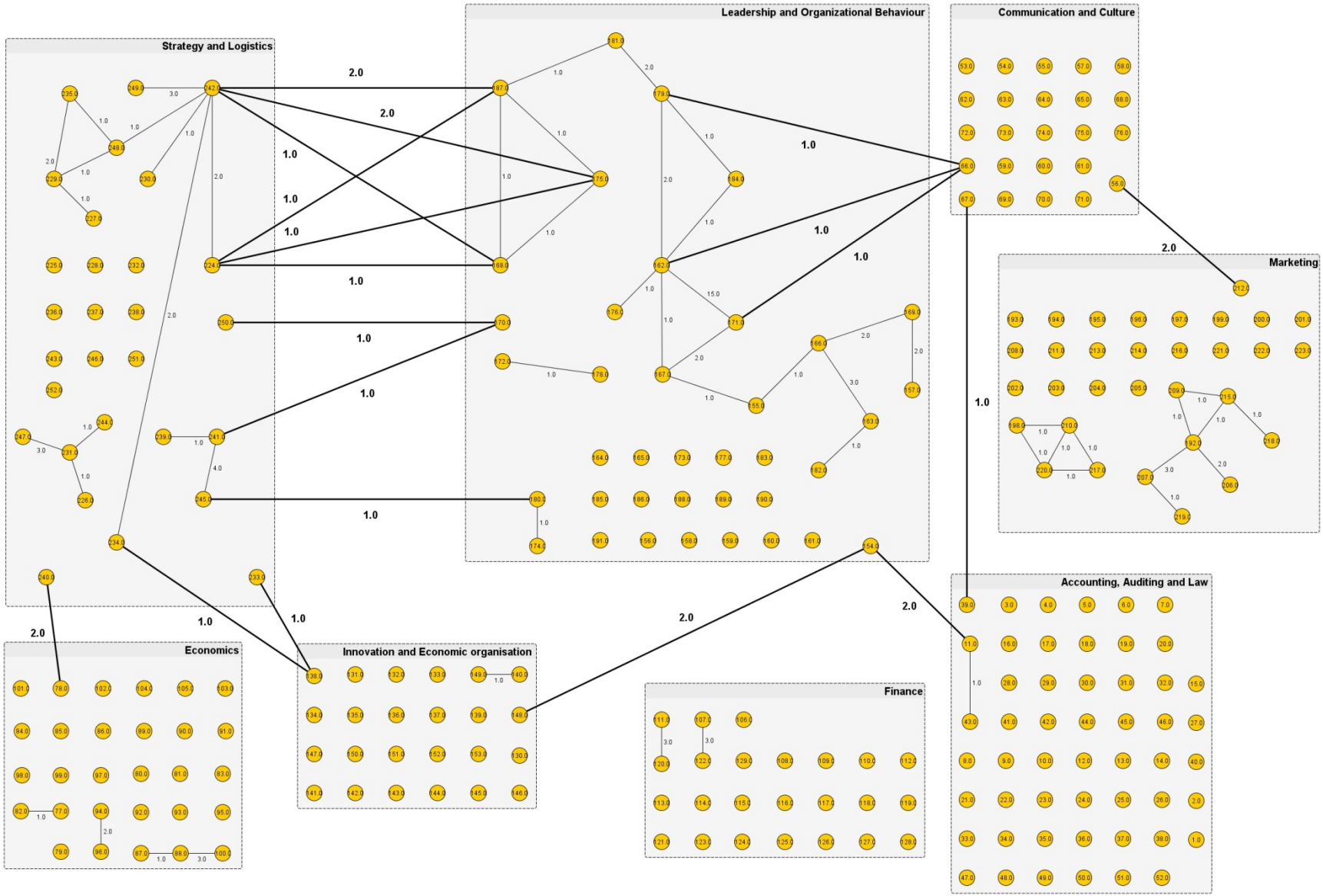

Figure 25. The interdepartmental coauthorship network

3. CLIQUES' ANALYSIS

The group of people that is interconnected by the socially strong relations form a clique (Luce & Perry, 1949). In terms of graph theory, every pair of persons in the group, forming the clique, has to be connected by an edge. Specifically, in terms of the research collaboration, the faculty members form cliques if each of them has published the joint scientific paper(s) with all other clique members.

In terms of this paper, we are looking for the maximum cliques and the *k*-cliques (with $k \geq 3$) in the coauthorship networks within the departmental and interdepartmental collaborations, where *k* is the number of faculty members forming the clique. Maximum clique is the largest group of faculty members that are collaborating in terms of publishing joint papers.

Finding the maximum clique is an NP-complete problem, and there are no algorithms solving the problem in polynomial time (Östergård, 2002). However, finding the maximum clique in comparatively small graphs, such as the BI coauthorship network, is a feasible task.

3.1 Departmental cliques

There are seven cliques of size *k*=3, which are represented within three departments out of eight:

1. Department of Leadership and Organizational Behaviour;
2. Department of Marketing;
3. Department of Strategy and Logistics.

All seven three-vertex cliques are represented in Figure 26:

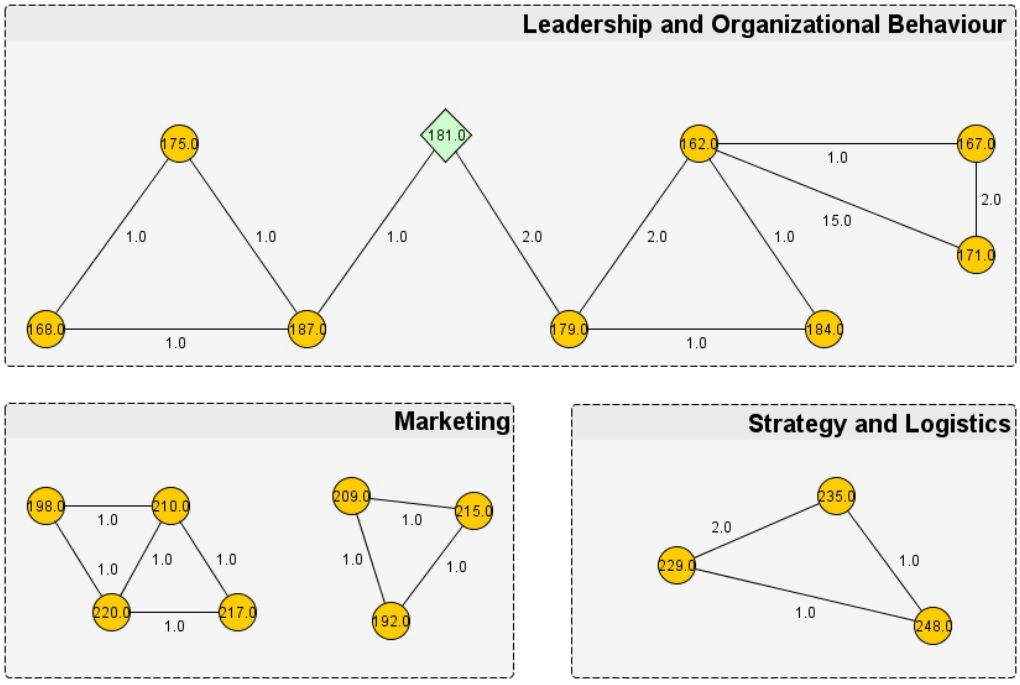

Figure 26. Three-vertex cliques within three departments

Cliques in the Department of Leadership and Organizational Behaviour:

(a) node 168 – node 175 – node 187;
(b) node 162 – node 179 – node 184;
(c) node 162 – node 167 – node 171.

Cliques in the Department Marketing:

(d) node 198 – node 210 – node 220;
(e) node 210 – node 217 – node 220;
(f) node 192 – node 209 – node 215.

Cliques in the Department Strategy and Logistics:

(g) node 229 – node 235 – node 248;

According to Figure 26 the core clique-based structure of the Department of Leadership and Organizational Behaviour is interconnected by the only hub-node "node 181" that is out of any clique, but it has publications with the members from both **(a)** and **(b)** cliques. Cliques **(b)** and **(c)** are connected to each other by the joint component "node 162". In the Department of Marketing cliques **(d)** and **(e)** are interconnected by the joint components "node 220" and "node 210".

3.2 Trans-departmental cliques

The trans-departmental clique is the clique where $k \geq 3$ and at least two clique members are the members of different departments. In this case, we are not interested in two-vertex trans-departmental cliques, because they simply correspond to the single interdepartmental links. This type of links is reported in Section 2.9.
There are three trans-departmental cliques detected in the BI coauthorship network (see Figure 27).

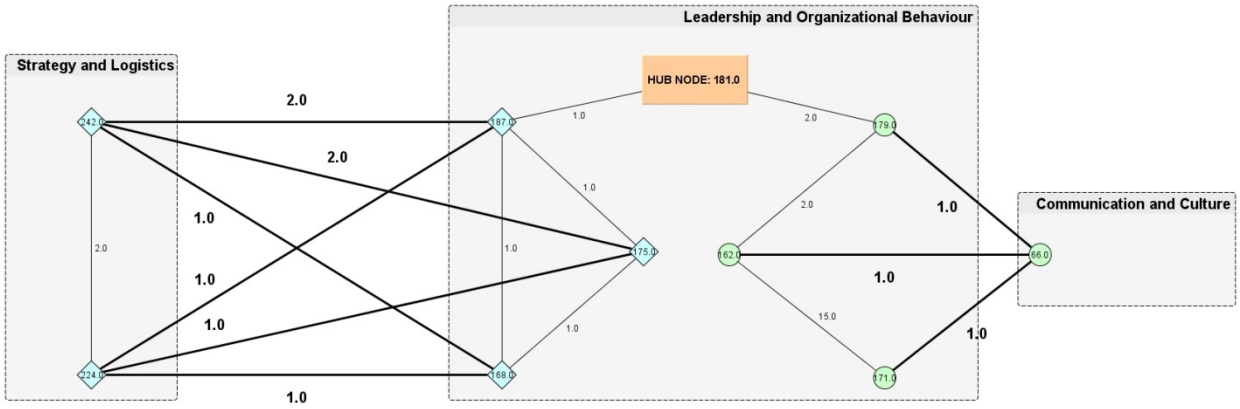

Figure 27. Trans-departmental cliques' structure

The maximum trans-departmental clique consists of five faculty members: “node 168”, “node 175”, “node 187”, “node 224”, and “node 242”. It is detected within two departments:

1. Department of Leadership and Organizational Behaviour;
2. Department Strategy and Logistics.

The second and third trans-departmental cliques are detected within the following departments:

1. Department of Leadership and Organizational Behaviour;
2. Department of Communication and Culture.

Specifically, there are two three-vertex cliques that contain the following faculty members:

1. “node 66” – “node 162” – “node 179”;
2. “node 66” – “node 162” – “node 171”;

It is important to notice the maximum clique is interconnected with the three-vertex cliques by the only hub “node 181” (see Figure 27). Obviously, the role of this hub is critical due to its “bottleneck”-nature. The deletion of this node would lead to the disconnection of two largest cliques-based trans-departmental sub-graphs.

4. SPANNING TREES AND SPANNING FORESTS

We analyze the interdepartmental coauthorship networks in order to detect the spanning trees and forests. Spanning tree is the minimal set of the network's edges (i.e. links) that connect the maximal number of nodes (i.e. faculty members) with no cycles (Cormen, Leiserson, Rivest, & Stein, 2003). Due to the fact that BI coauthorship network is represented by the set of disconnected graphs, we are looking for the set of spanning trees of the disconnected components, which is called a spanning forest (Bollobás, 1998).

Analyzing cliques in Section 3 we detected the groups of the most strongly connected faculty members in terms of the coauthorship, but detecting the spanning trees we are looking for the overall affiliation of the faculty members within the BI research community. Spanning forest structure ignores the detailed interpersonal relations due to the requirement to avoid cycles, but it shows the spreading of the different research interests over the BI coauthorship network. In this section we analyze the spanning forest for the interdepartmental relations (i.e., trans-departmental spanning forest).

Trans-departmental spanning forest is the set of interdepartmental spanning trees, where at least one edge in each of these trees connects the faculty members from different departments.

The overall trans-departmental spanning forest is formed based on the coauthorship network of seven departments:

1. Department of Accounting, Auditing and Law;
2. Department of Communication and Culture;
3. Department of Economics;
4. Department of Innovation and Economic Organisation;
5. Department of Leadership and Organizational Behaviour;
6. Department of Marketing;
7. Department of Strategy and Logistics.

The spanning forest structure is represented in Figure 28.

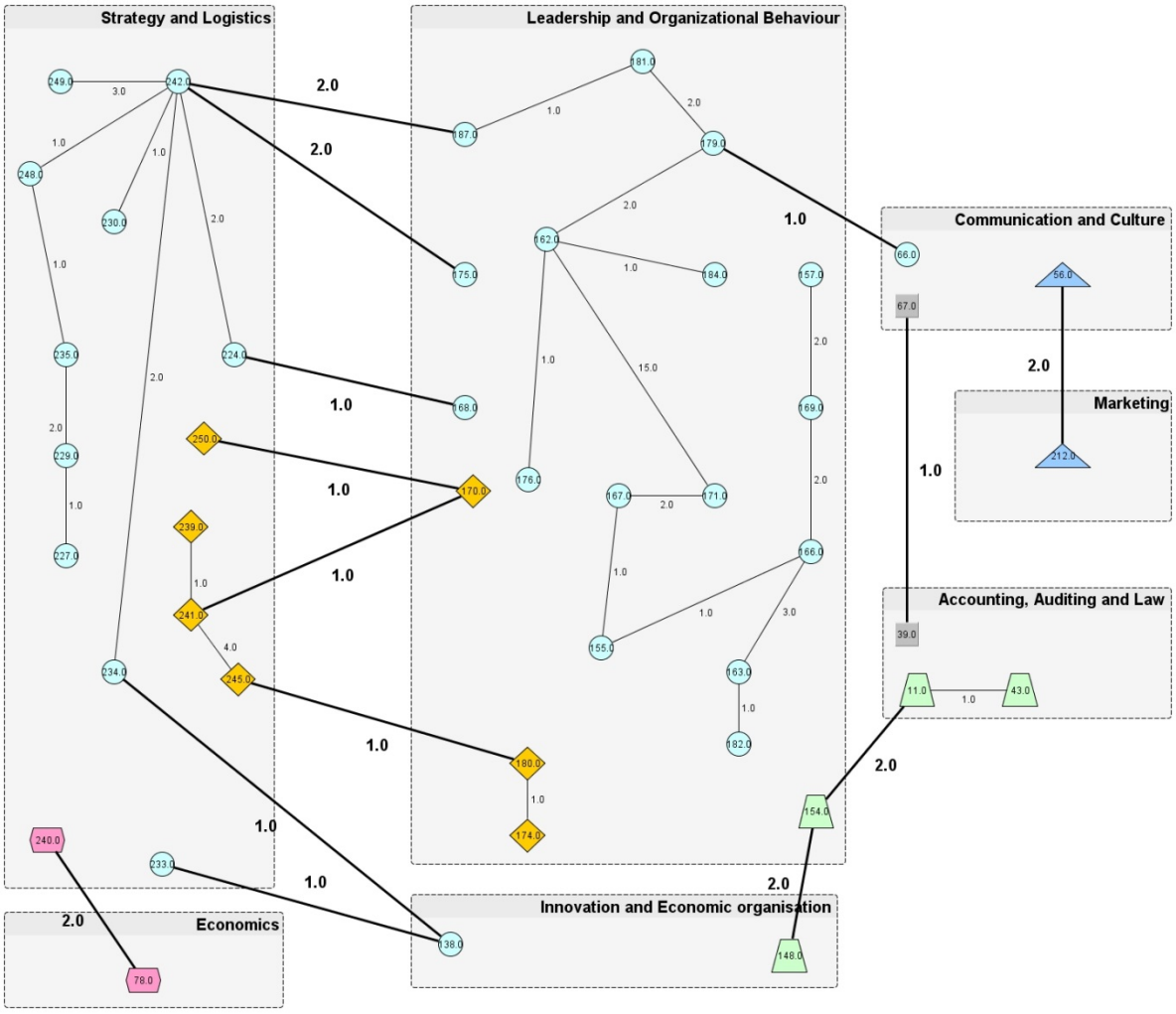

Figure 28. Trans-departmental spanning forest

According to Figure 28 the spanning forest consists of six spanning trees.
The maximal spanning tree (see Figure 29) covers four departments and includes 28 faculty members listed in Table 10.

Table 10. Maximal spanning tree in the trans-departmental forest

Department of Leadership and Organizational Behaviour				Department of Strategy and Logistics		Department of Communication and Culture		Department of Innovation and Economic Organization	
1	node 155	9	node 171	17	node 224	27	node 66	28	node 138
2	node 157	10	node 175	18	node 227				
3	node 162	11	node 176	19	node 229				
4	node 163	12	node 179	20	node 230				
5	node 166	13	node 181	21	node 233				
6	node 167	14	node 182	22	node 234				
7	node 168	15	node 184	23	node 235				
8	node 169	16	node 187	24	node 242				
				25	node 248				
				26	node 249				

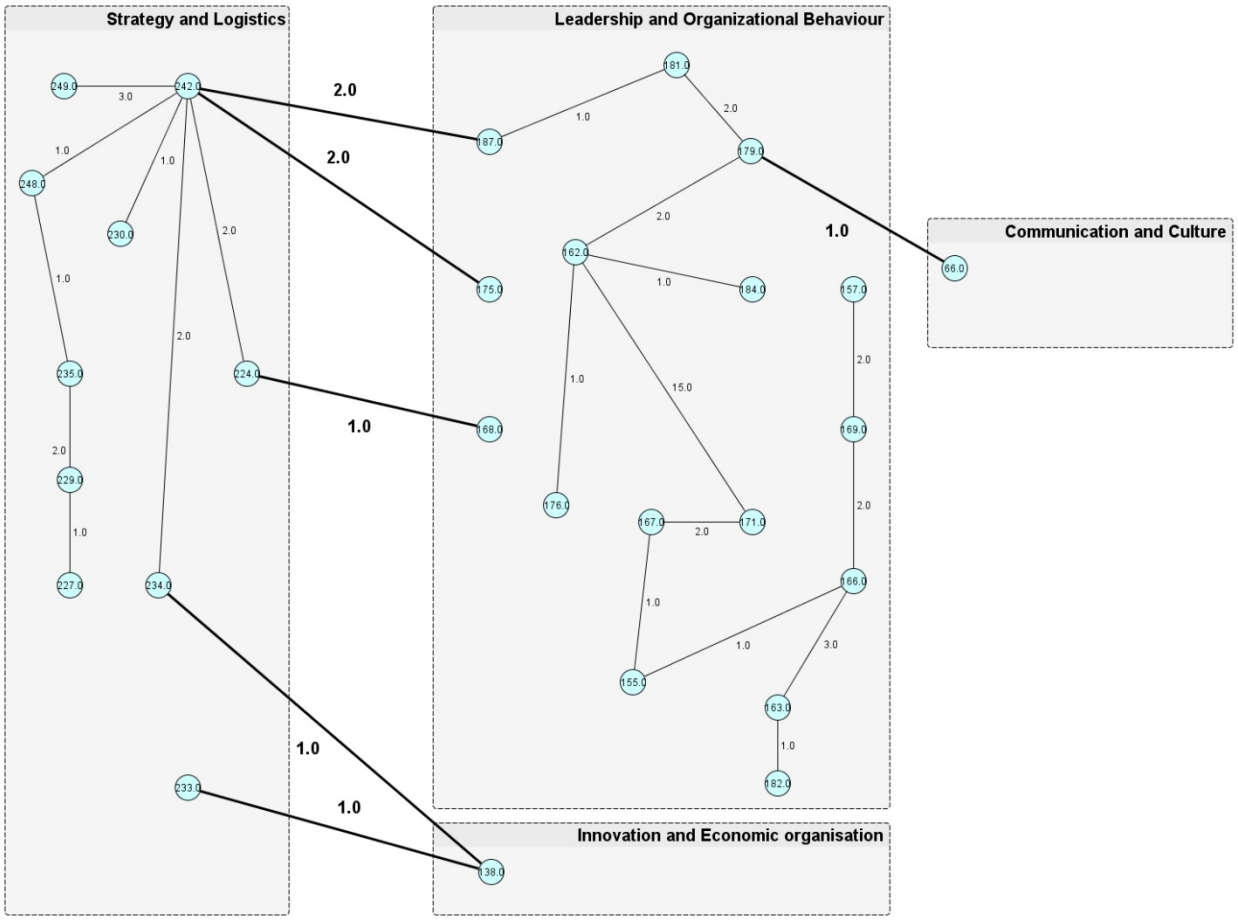

Figure 29. Maximal spanning tree in the trans-departmental forest

The second largest spanning tree consists of seven faculty member from two departments (see Table 11):

Table 11. The second largest spanning tree in the trans-departmental forest

Department of Strategy and Logistics		Department of Leadership and Organizational Behaviour	
1	node 239	1	node 170
2	node 241	2	node 174
3	node 245	3	node 180
4	node 250		

The spanning tree that corresponds to Table 11 is represented in Figure 30.

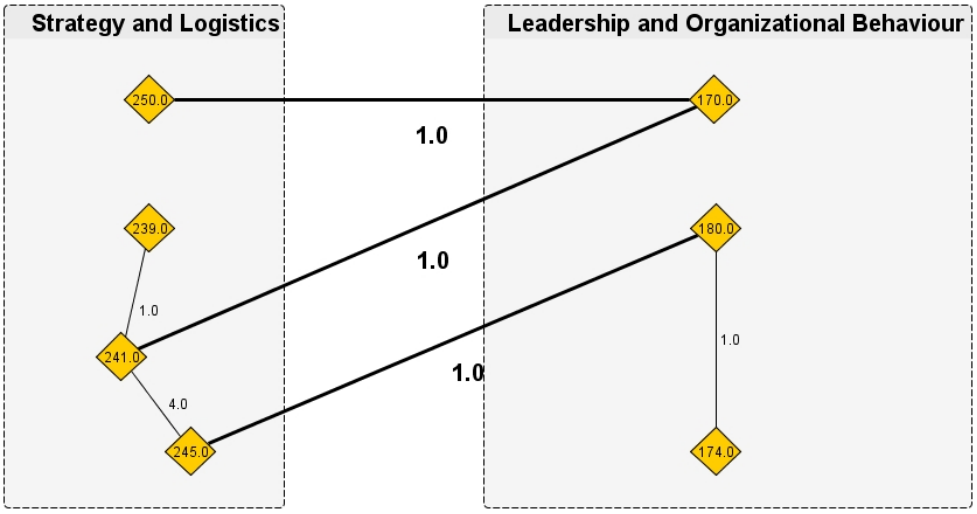

Figure 30. Second largest spanning tree in the trans-departmental forest

The third largest spanning three (see Figure 31) is based on the coauthorship relations between the Department of Accounting, Auditing and Law ("node 11" and "node 43"), the Department of Innovation and Economic Organisation ("node 148"), and the Department of Leadership and Organizational Behaviour ("node 154").

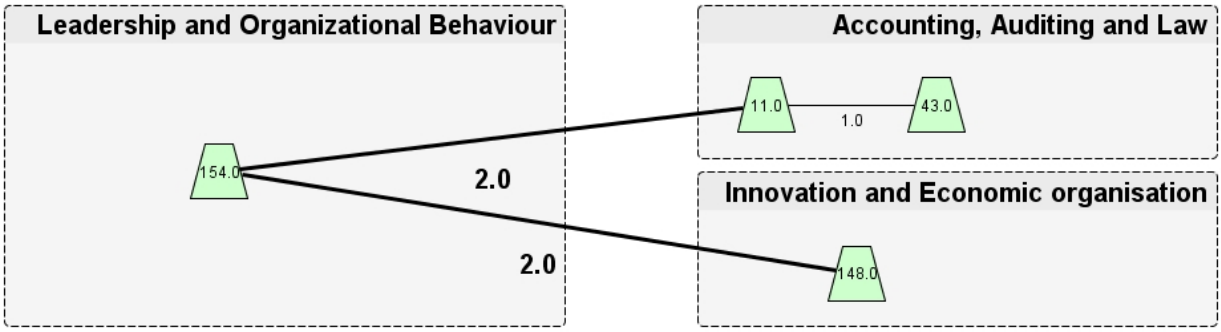

Figure 31. The third largest spanning tree in the trans-departmental forest

The fourth, fifth and sixth spanning trees are two-vertex trans-departmental connections represented in Figure 32.

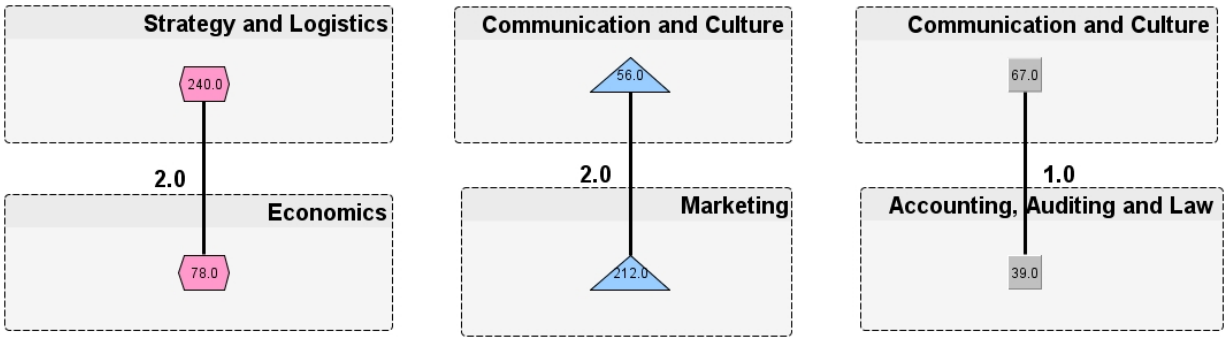

Figure 32. Fourth, fifth and sixth spanning trees in the trans-departmental forest

5. INTERNATIONAL COAUTHORSHIP

In this section we analyse the existing international coauthorship (based on *the ISI Web of Science*) that cover all countries excepting Norway. We investigate how many faculty members at the BI coauthorship network should be deleted in order for the international coauthorship to be vanishing. To approach this goal we sort the faculty members by the number of international coauthorship (i.e., by the number of coauthors from non-Norwegian institutions) in the descending order. Then, we delete them from the list one by one until we get the international coauthorship vanished. This procedure is done for the BI departments in sections 5.1 – 5.8 and for the overall BI coauthorship in section 5.9.

We represent the results in tabular format (see Tables 12-20) where we provide the following information:

- "number of coauthorship" is the number of international coauthors for the corresponding faculty member;
- "overall after exclusion" is the number of the overall international coauthorship left after excluding the current author and authors excluded earlier in the sorted list.
- "% out of overall coauthorship" is the percentage of the faculty member's contribution out of the overall BI international coauthorship.
- "Overall % after exclusion" is the overall percentage of international coauthorship after excluding the current author and authors excluded earlier in the sorted list.

The graphical representation is given in Figures 33-41.

5.1 Department of Accounting, Auditing and Law

There are 55 international coauthorships in the Department. The sorted list of faculty members is represented in Table 12. The deletion of 9 out of 52 (approximately, 17% out of 100%) faculty members will lead to the vanishing of the international coauthorship. It is important to notice that the deletion of only 2 out of 52 faculty members (i.e., approx. 4% out of 100%) will bring almost 62% reduction of the departmental international coauthorship.
The given results are represented in Figure 33.

Table 12. Department of Accounting, Auditing and Law:
International coathorship by faculty members

	Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion			Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion
1	node 38	25	30	45.5	54.5		27	node 20	0	0	0.0	0.0
2	node 43	9	21	16.4	38.2		28	node 21	0	0	0.0	0.0
3	node 37	7	14	12.7	25.5		29	node 22	0	0	0.0	0.0
4	node 36	4	10	7.3	18.2		30	node 23	0	0	0.0	0.0
5	node 11	3	7	5.5	12.7		31	node 24	0	0	0.0	0.0
6	node 29	3	4	5.5	7.3		32	node 25	0	0	0.0	0.0
7	node 27	2	2	3.6	3.6		33	node 26	0	0	0.0	0.0
8	node 10	1	1	1.8	1.8		34	node 28	0	0	0.0	0.0
9	node 42	1	0	1.8	0.0		35	node 30	0	0	0.0	0.0
10	node 1	0	0	0.0	0.0		36	node 31	0	0	0.0	0.0
11	node 2	0	0	0.0	0.0		37	node 32	0	0	0.0	0.0
12	node 3	0	0	0.0	0.0		38	node 33	0	0	0.0	0.0
13	node 4	0	0	0.0	0.0		39	node 34	0	0	0.0	0.0
14	node 5	0	0	0.0	0.0		40	node 35	0	0	0.0	0.0
15	node 6	0	0	0.0	0.0		41	node 39	0	0	0.0	0.0
16	node 7	0	0	0.0	0.0		42	node 40	0	0	0.0	0.0
17	node 8	0	0	0.0	0.0		43	node 41	0	0	0.0	0.0
18	node 9	0	0	0.0	0.0		44	node 44	0	0	0.0	0.0
19	node 12	0	0	0.0	0.0		45	node 45	0	0	0.0	0.0
20	node 13	0	0	0.0	0.0		46	node 46	0	0	0.0	0.0
21	node 14	0	0	0.0	0.0		47	node 47	0	0	0.0	0.0
22	node 15	0	0	0.0	0.0		48	node 48	0	0	0.0	0.0
23	node 16	0	0	0.0	0.0		49	node 49	0	0	0.0	0.0
24	node 17	0	0	0.0	0.0		50	node 50	0	0	0.0	0.0
25	node 18	0	0	0.0	0.0		51	node 51	0	0	0.0	0.0
26	node 19	0	0	0.0	0.0		52	node 52	0	0	0.0	0.0

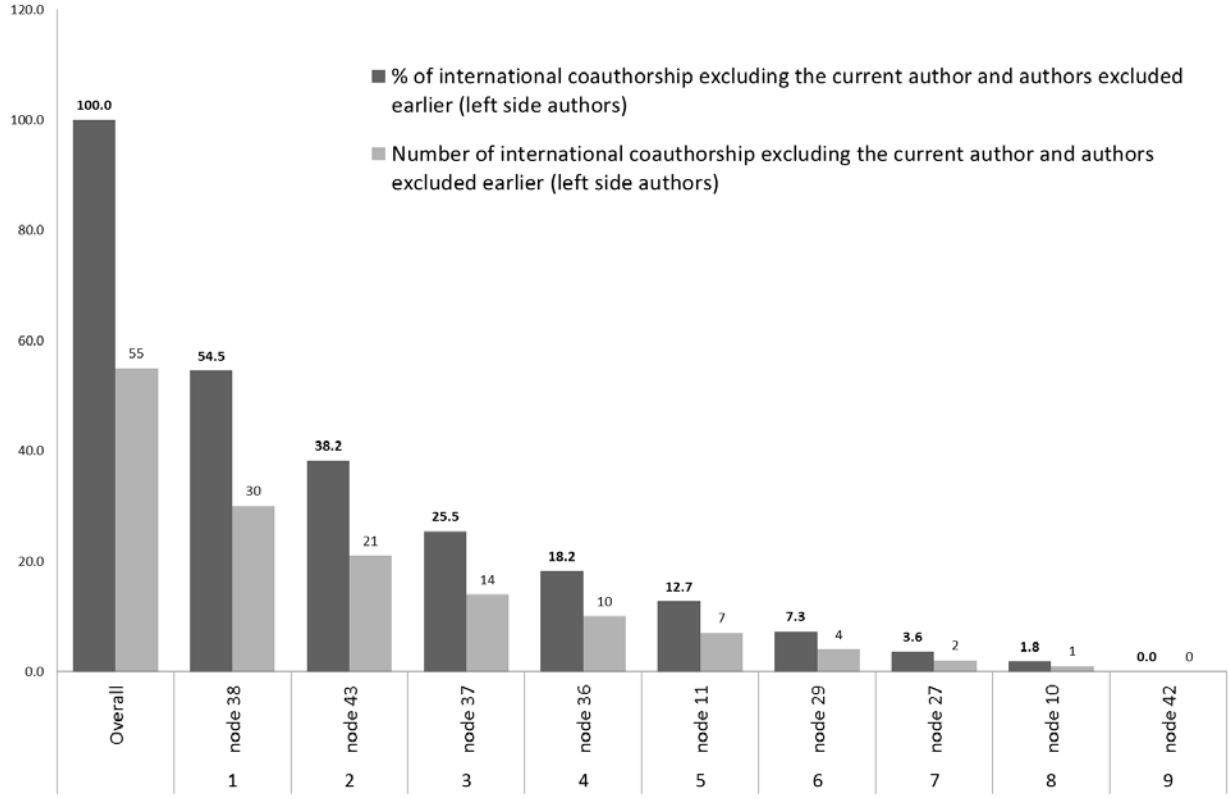

Figure 33. Department of Accounting, Auditing and Law:
International coauthorship based on the sequential faculty members' deletion

5.2 Department of Communication and Culture

There are 53 international coauthorships in the Department. The sorted list of faculty members is represented in Table 13. The deletion of 5 out of 24 (approximately, 21% out of 100%) faculty members will lead to the vanishing of the international coauthorship. It is important to notice that the deletion of only 1 out of 24 faculty members (i.e., approx. 4% out of 100%) will bring more than 73% reduction of the departmental international coauthorship.
The given results are represented in Figure 34.

Table 13. Department of Communication and Culture:
International coathorship by faculty members

	Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion			Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion
1	node 67	39	14	73.6	26.4		13	node 62	0	0	0.0	0.0
2	node 59	8	6	15.1	11.3		14	node 63	0	0	0.0	0.0
3	node 66	3	3	5.7	5.7		15	node 64	0	0	0.0	0.0
4	node 72	2	1	3.8	1.9		16	node 65	0	0	0.0	0.0
5	node 56	1	0	1.9	0.0		17	node 68	0	0	0.0	0.0
6	node 53	0	0	0.0	0.0		18	node 69	0	0	0.0	0.0
7	node 54	0	0	0.0	0.0		19	node 70	0	0	0.0	0.0
8	node 55	0	0	0.0	0.0		20	node 71	0	0	0.0	0.0
9	node 57	0	0	0.0	0.0		21	node 73	0	0	0.0	0.0
10	node 58	0	0	0.0	0.0		22	node 74	0	0	0.0	0.0
11	node 60	0	0	0.0	0.0		23	node 75	0	0	0.0	0.0
12	node 61	0	0	0.0	0.0		24	node 76	0	0	0.0	0.0

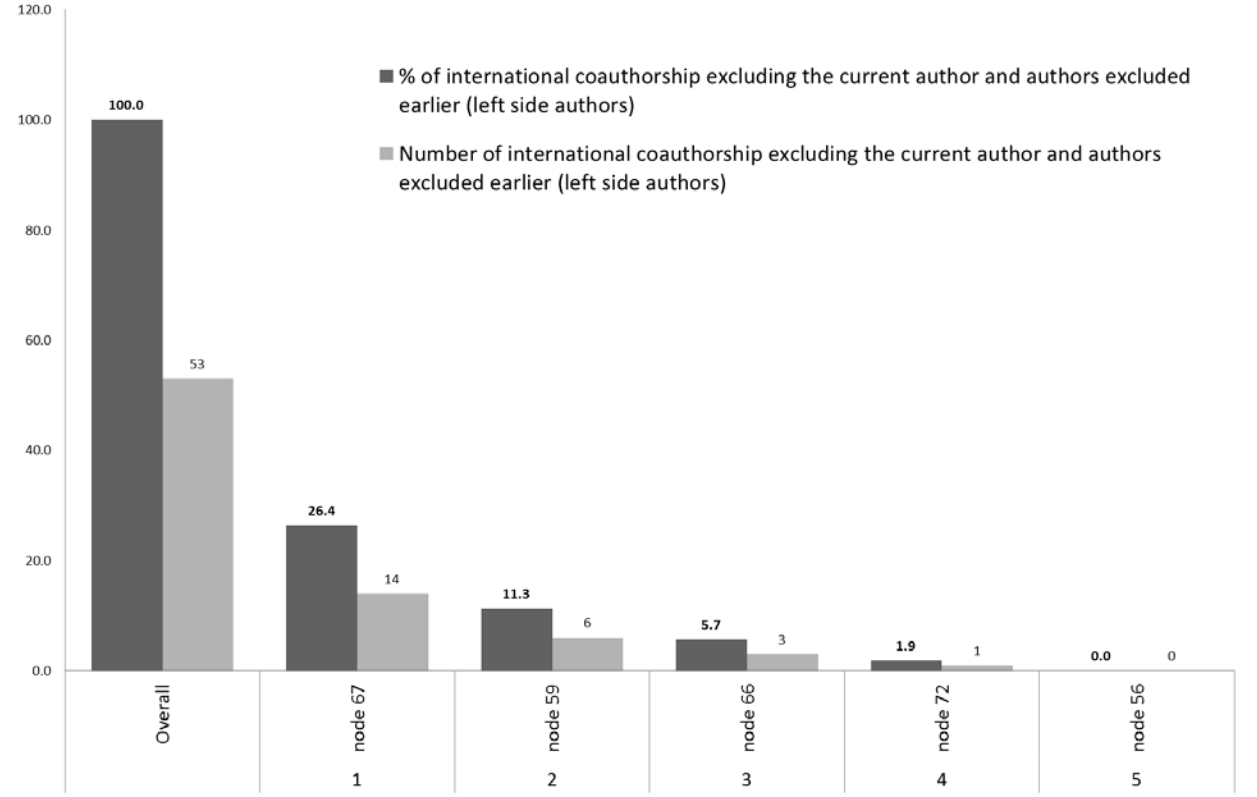

Figure 34. Department of Communication and Culture:
International coauthorship based on the sequential faculty members' deletion

5.3 Department of Economics

There are 119 international coauthorships in the Department. The sorted list of faculty members is represented in Table 14. The deletion of 13 out of 29 (approximately, 45% out of 100%) faculty members will lead to the vanishing of the international coauthorship. It is important to notice that the deletion of only 2 out of 29 faculty members (i.e., approx. 7% out of 100%) will bring almost 53% reduction of the departmental international coauthorship.
The given results are represented in Figure 35.

Table 14. Department of Economics:
International coathorship by faculty members

	Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion			Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion
1	node 83	40	79	33.6	66.4		16	node 81	0	0	0.0	0.0
2	node 79	23	56	19.3	47.1		17	node 82	0	0	0.0	0.0
3	node 94	15	41	12.6	34.5		18	node 84	0	0	0.0	0.0
4	node 103	11	30	9.2	25.2		19	node 85	0	0	0.0	0.0
5	node 96	8	22	6.7	18.5		20	node 86	0	0	0.0	0.0
6	node 99	5	17	4.2	14.3		21	node 87	0	0	0.0	0.0
7	node 98	4	13	3.4	10.9		22	node 88	0	0	0.0	0.0
8	node 101	4	9	3.4	7.6		23	node 89	0	0	0.0	0.0
9	node 93	3	6	2.5	5.0		24	node 90	0	0	0.0	0.0
10	node 102	3	3	2.5	2.5		25	node 91	0	0	0.0	0.0
11	node 77	1	2	0.8	1.7		26	node 92	0	0	0.0	0.0
12	node 100	1	1	0.8	0.8		27	node 95	0	0	0.0	0.0
13	node 104	1	0	0.8	0.0		28	node 97	0	0	0.0	0.0
14	node 78	0	0	0.0	0.0		29	node 105	0	0	0.0	0.0
15	node 80	0	0	0.0	0.0							

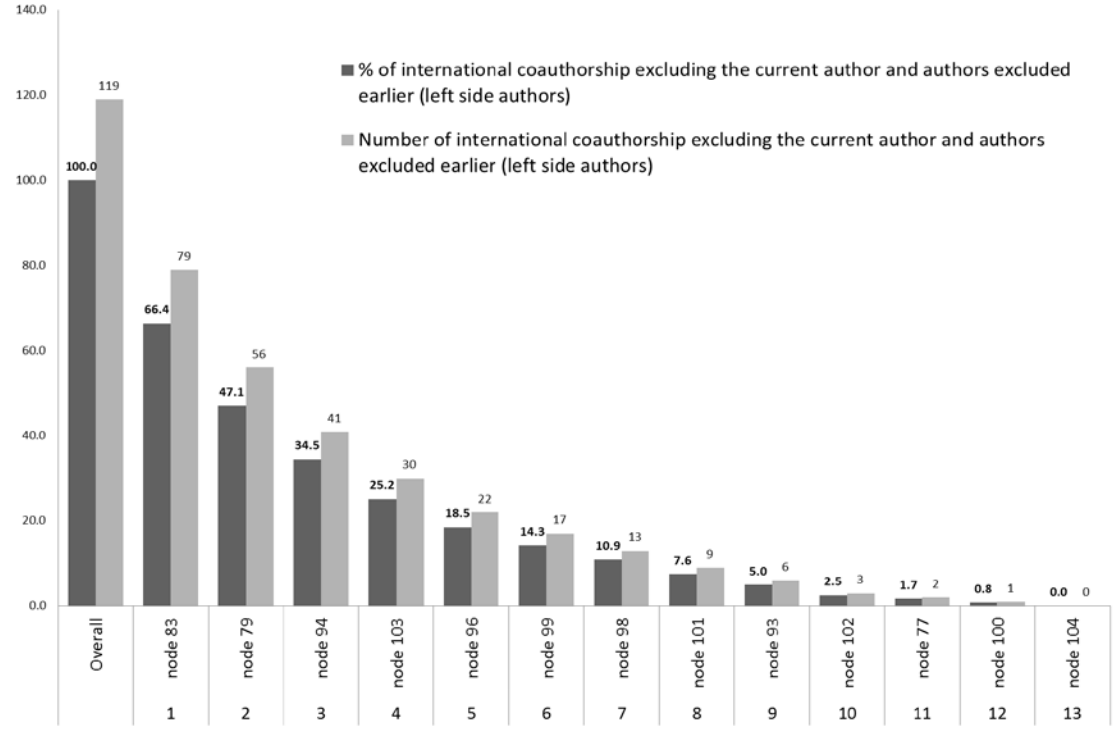

Figure 35. Department of Economics:
International coauthorship based on the sequential faculty members' deletion

5.4. Department of Finance

There are 64 international coauthorships in the Department. The sorted list of faculty members is represented in Table 15. The deletion of 10 out of 24 (approximately, 42% out of 100%) faculty members will lead to the vanishing of the international coauthorship. It is important to notice that the deletion of only 2 out of 24 faculty members (i.e., approx. 8% out of 100%) will bring more than 56% reduction of the departmental international coauthorship.
The given results are represented in Figure 36.

Table 15. Department of Finance: International coathorship by faculty members

	Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion			Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion
1	node 120	22	42	34.4	65.6		13	node 110	0	0	0.0	0.0
2	node 122	14	28	21.9	43.8		14	node 111	0	0	0.0	0.0
3	node 113	8	20	12.5	31.3		15	node 114	0	0	0.0	0.0
4	node 118	5	15	7.8	23.4		16	node 115	0	0	0.0	0.0
5	node 119	5	10	7.8	15.6		17	node 116	0	0	0.0	0.0
6	node 127	3	7	4.7	10.9		18	node 117	0	0	0.0	0.0
7	node 106	2	5	3.1	7.8		19	node 121	0	0	0.0	0.0
8	node 108	2	3	3.1	4.7		20	node 123	0	0	0.0	0.0
9	node 129	2	1	3.1	1.6		21	node 124	0	0	0.0	0.0
10	node 112	1	0	1.6	0.0		22	node 125	0	0	0.0	0.0
11	node 107	0	0	0.0	0.0		23	node 126	0	0	0.0	0.0
12	node 109	0	0	0.0	0.0		24	node 128	0	0	0.0	0.0

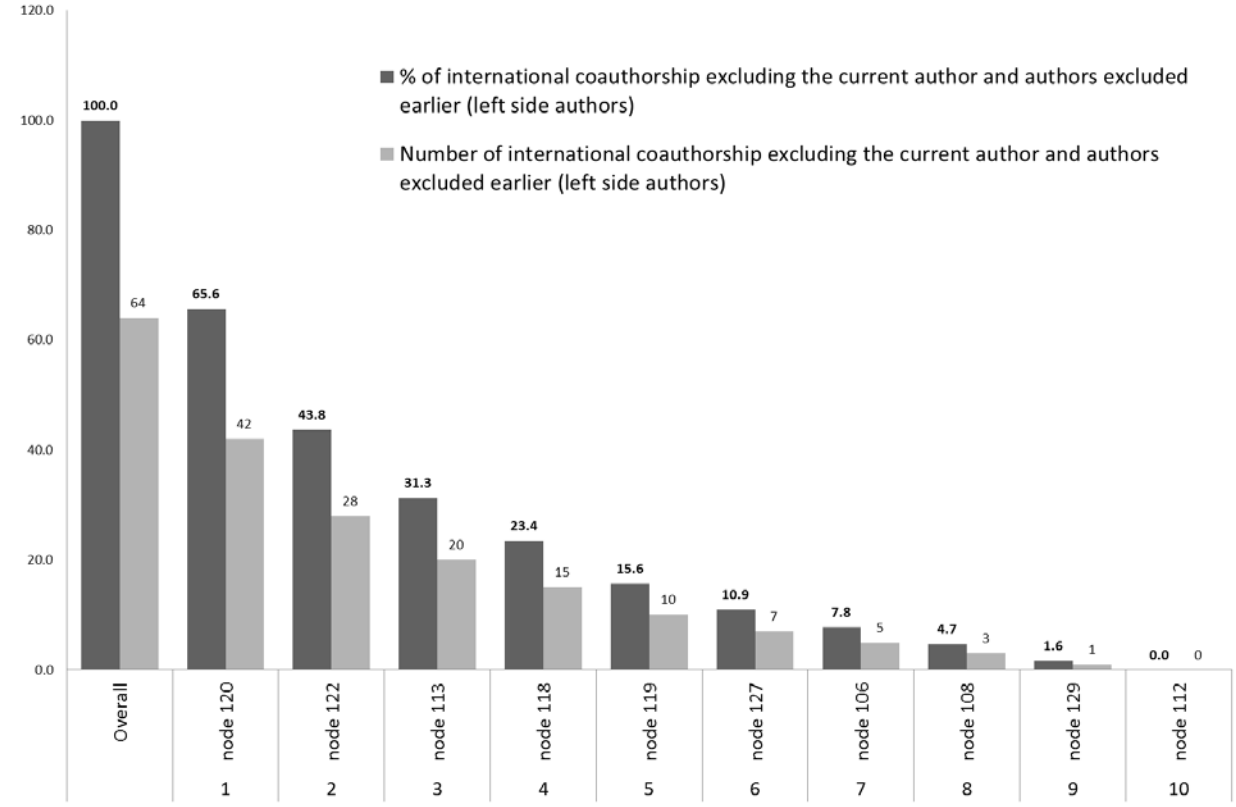

Figure 36. Department of Finance:
International coauthorship based on the sequential faculty members' deletion

5.5 Department of Innovation and Economic Organisation

There are 61 international coauthorships in the Department. The sorted list of faculty members is represented in Table 16. The deletion of 7 out of 24 (approximately, 29% out of 100%) faculty members will lead to the vanishing of the international coauthorship. It is important to notice that the deletion of only 1 out of 24 faculty members (i.e., approx. 4% out of 100%) will bring almost 50% reduction of the departmental international coauthorship.
The given results are represented in Figure 37.

Table 16. Department of Innovation and Economic Organisation: International coathorship by faculty members

	Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion			Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion
1	node 138	30	31	49.2	50.8		13	node 139	0	0	0.0	0.0
2	node 148	13	18	21.3	29.5		14	node 141	0	0	0.0	0.0
3	node 132	6	12	9.8	19.7		15	node 142	0	0	0.0	0.0
4	node 145	5	7	8.2	11.5		16	node 143	0	0	0.0	0.0
5	node 130	4	3	6.6	4.9		17	node 144	0	0	0.0	0.0
6	node 140	2	1	3.3	1.6		18	node 146	0	0	0.0	0.0
7	node 133	1	0	1.6	0.0		19	node 147	0	0	0.0	0.0
8	node 131	0	0	0.0	0.0		20	node 149	0	0	0.0	0.0
9	node 134	0	0	0.0	0.0		21	node 150	0	0	0.0	0.0
10	node 135	0	0	0.0	0.0		22	node 151	0	0	0.0	0.0
11	node 136	0	0	0.0	0.0		23	node 152	0	0	0.0	0.0
12	node 137	0	0	0.0	0.0		24	node 153	0	0	0.0	0.0

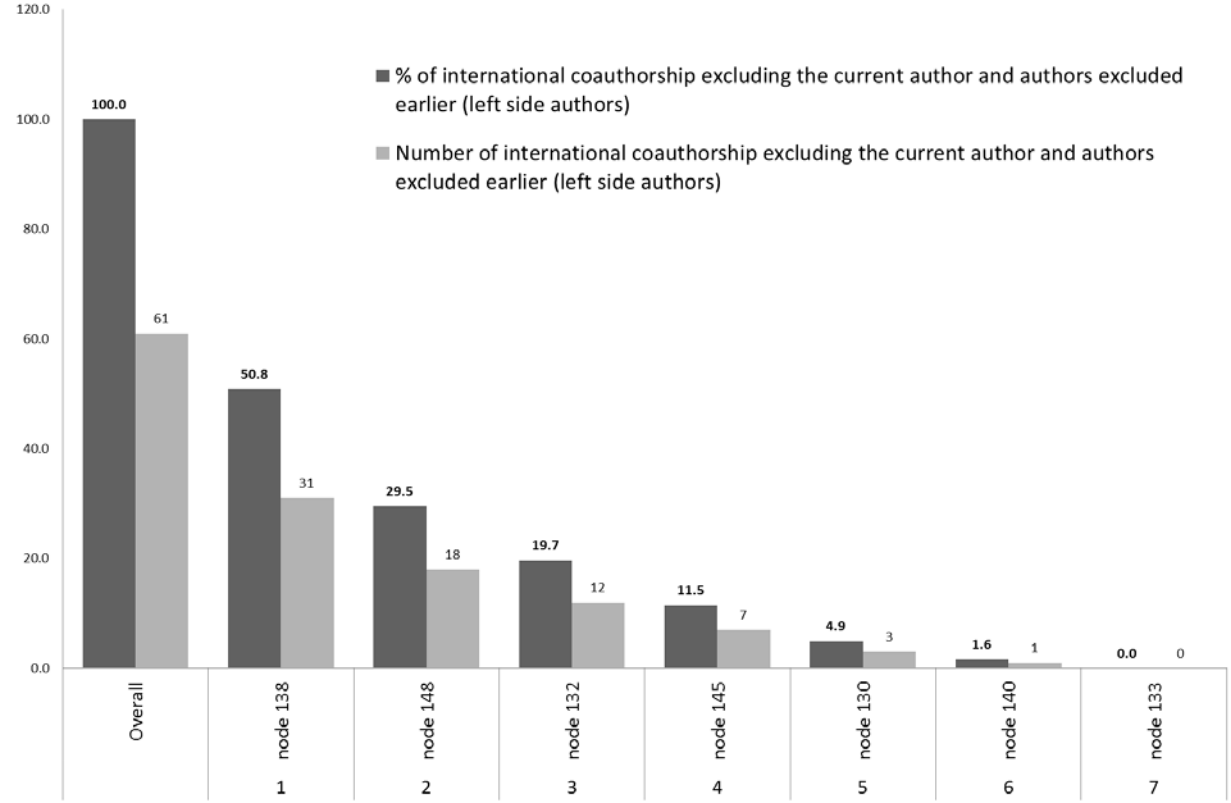

Figure 37. Department of Innovation and Economic Organisation: International coauthorship based on the sequential faculty members' deletion

5.6 Department of Leadership and Organizational Behaviour

There are 261 international coauthorships in the Department. The sorted list of faculty members is represented in Table 17. The deletion of 20 out of 38 (approximately, 53% out of 100%) faculty members will lead to the vanishing of the international coauthorship. It is important to notice that the deletion of only 3 out of 38 faculty members (i.e., approx. 8% out of 100%) will bring almost 54% reduction of the departmental international coauthorship.
The given results are represented in Figure 38.

Table 17. Department of Leadership and Organizational Behaviour: International coathorship by faculty members

	Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion			Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion
1	node 184	66	195	25.3	74.7		20	node 186	1	0	0.4	0.0
2	node 181	39	156	14.9	59.8		21	node 156	0	0	0.0	0.0
3	node 185	35	121	13.4	46.4		22	node 157	0	0	0.0	0.0
4	node 178	22	99	8.4	37.9		23	node 158	0	0	0.0	0.0
5	node 189	19	80	7.3	30.7		24	node 160	0	0	0.0	0.0
6	node 174	18	62	6.9	23.8		25	node 161	0	0	0.0	0.0
7	node 167	11	51	4.2	19.5		26	node 163	0	0	0.0	0.0
8	node 175	11	40	4.2	15.3		27	node 164	0	0	0.0	0.0
9	node 166	8	32	3.1	12.3		28	node 168	0	0	0.0	0.0
10	node 172	6	26	2.3	10.0		29	node 169	0	0	0.0	0.0
11	node 171	5	21	1.9	8.0		30	node 170	0	0	0.0	0.0
12	node 155	4	17	1.5	6.5		31	node 176	0	0	0.0	0.0
13	node 165	4	13	1.5	5.0		32	node 177	0	0	0.0	0.0
14	node 182	4	9	1.5	3.4		33	node 180	0	0	0.0	0.0
15	node 154	2	7	0.8	2.7		34	node 183	0	0	0.0	0.0
16	node 159	2	5	0.8	1.9		35	node 187	0	0	0.0	0.0
17	node 162	2	3	0.8	1.1		36	node 188	0	0	0.0	0.0
18	node 173	1	2	0.4	0.8		37	node 190	0	0	0.0	0.0
19	node 179	1	1	0.4	0.4		38	node 191	0	0	0.0	0.0

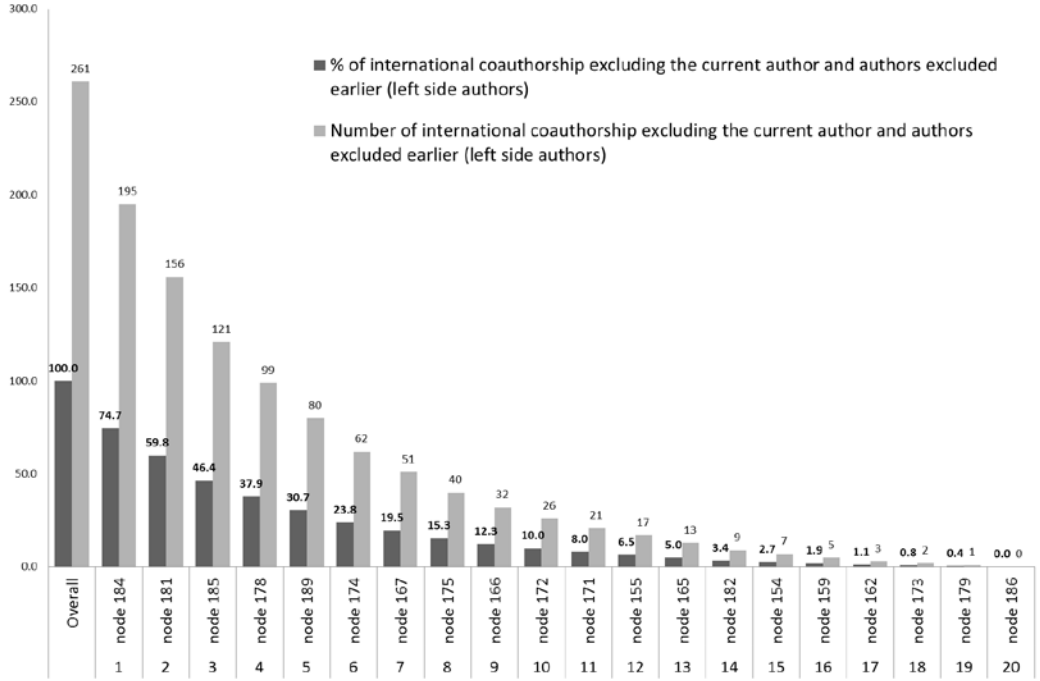

Figure 38. Department of Leadership and Organizational Behaviour: International coauthorship based on the sequential faculty members' deletion

5.7 Department of Marketing

There are 239 international coauthorships in the Department. The sorted list of faculty members is represented in Table 18. The deletion of 18 out of 32 (approximately, 56% out of 100%) faculty members will lead to the vanishing of the international coauthorship. It is important to notice that the deletion of only 1 out of 32 faculty members (i.e., approx. 3% out of 100%) will bring more than 53% reduction of the departmental international coauthorship.
The given results are represented in Figure 39.

Table 18. Department of Marketing: International coathorship by faculty embers

	Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion			Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion
1	node 223	127	112	53.1	46.9		17	node 218	1	1	0.4	0.4
2	node 192	36	76	15.1	31.8		18	node 222	1	0	0.4	0.0
3	node 211	10	66	4.2	27.6		19	node 193	0	0	0.0	0.0
4	node 220	10	56	4.2	23.4		20	node 195	0	0	0.0	0.0
5	node 194	9	47	3.8	19.7		21	node 196	0	0	0.0	0.0
6	node 212	9	38	3.8	15.9		22	node 197	0	0	0.0	0.0
7	node 200	7	31	2.9	13.0		23	node 199	0	0	0.0	0.0
8	node 203	5	26	2.1	10.9		24	node 202	0	0	0.0	0.0
9	node 210	5	21	2.1	8.8		25	node 204	0	0	0.0	0.0
10	node 215	4	17	1.7	7.1		26	node 205	0	0	0.0	0.0
11	node 198	3	14	1.3	5.9		27	node 206	0	0	0.0	0.0
12	node 201	3	11	1.3	4.6		28	node 208	0	0	0.0	0.0
13	node 207	3	8	1.3	3.3		29	node 209	0	0	0.0	0.0
14	node 219	3	5	1.3	2.1		30	node 213	0	0	0.0	0.0
15	node 217	2	3	0.8	1.3		31	node 214	0	0	0.0	0.0
16	node 216	1	2	0.4	0.8		32	node 221	0	0	0.0	0.0

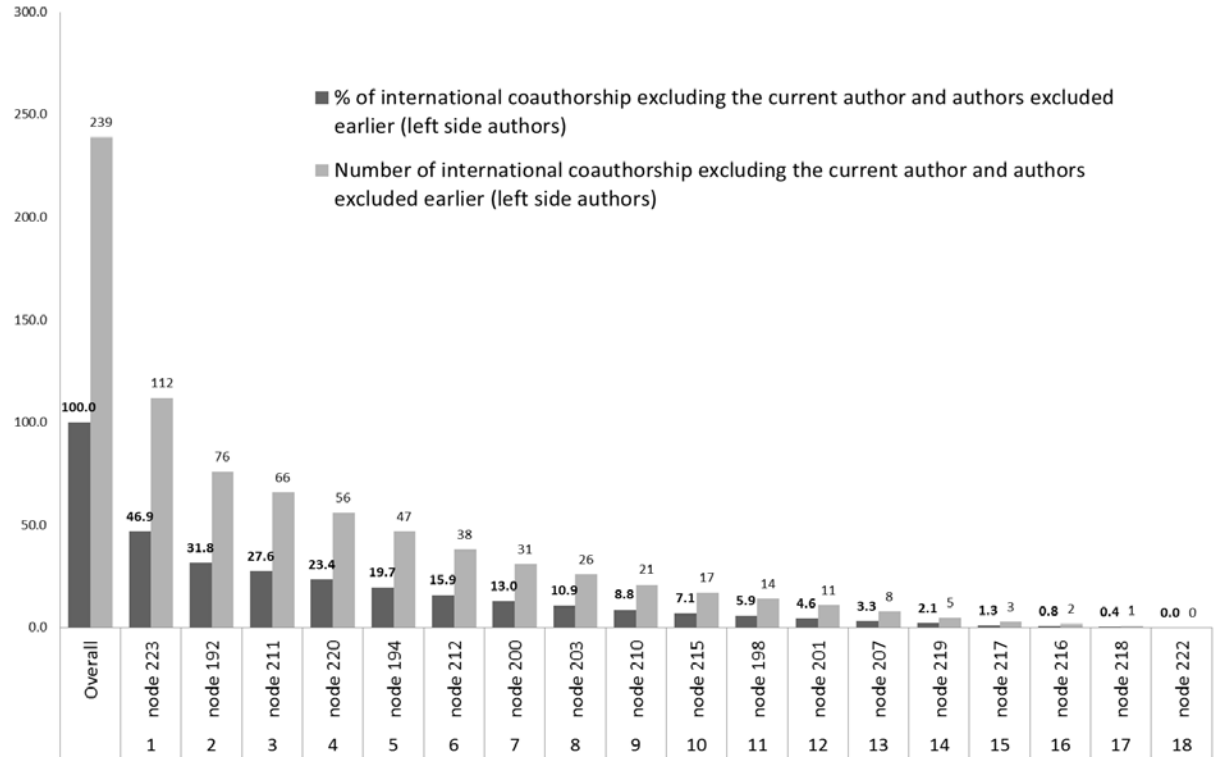

Figure 39. Department of Marketing:
International coauthorship based on the sequential faculty members' deletion

5.8 Department of Strategy and Logistics

There are 151 international coauthorships in the Department. The sorted list of faculty members is represented in Table 19. The deletion of 20 out of 29 (approximately, 69% out of 100%) faculty members will lead to the vanishing of the international coauthorship. It is important to notice that the deletion of only 4 out of 29 faculty members (i.e., approx. 14% out of 100%) will bring more than 53% reduction of the departmental international coauthorship.
The given results are represented in Figure 40.

Table 19. Department of Strategy and Logistics:
International coathorship by faculty embers

	Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion			Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion
1	node 238	28	123	18.5	81.5		16	node 244	2	5	1.3	3.3
2	node 243	24	99	15.9	65.6		17	node 252	2	3	1.3	2.0
3	node 231	19	80	12.6	53.0		18	node 232	1	2	0.7	1.3
4	node 240	10	70	6.6	46.4		19	node 241	1	1	0.7	0.7
5	node 228	9	61	6.0	40.4		20	node 249	1	0	0.7	0.0
6	node 233	9	52	6.0	34.4		21	node 225	0	0	0.0	0.0
7	node 224	8	44	5.3	29.1		22	node 226	0	0	0.0	0.0
8	node 246	8	36	5.3	23.8		23	node 227	0	0	0.0	0.0
9	node 234	6	30	4.0	19.9		24	node 230	0	0	0.0	0.0
10	node 237	6	24	4.0	15.9		25	node 236	0	0	0.0	0.0
11	node 229	5	19	3.3	12.6		26	node 245	0	0	0.0	0.0
12	node 242	4	15	2.6	9.9		27	node 248	0	0	0.0	0.0
13	node 247	4	11	2.6	7.3		28	node 250	0	0	0.0	0.0
14	node 235	2	9	1.3	6.0		29	node 251	0	0	0.0	0.0
15	node 239	2	7	1.3	4.6							

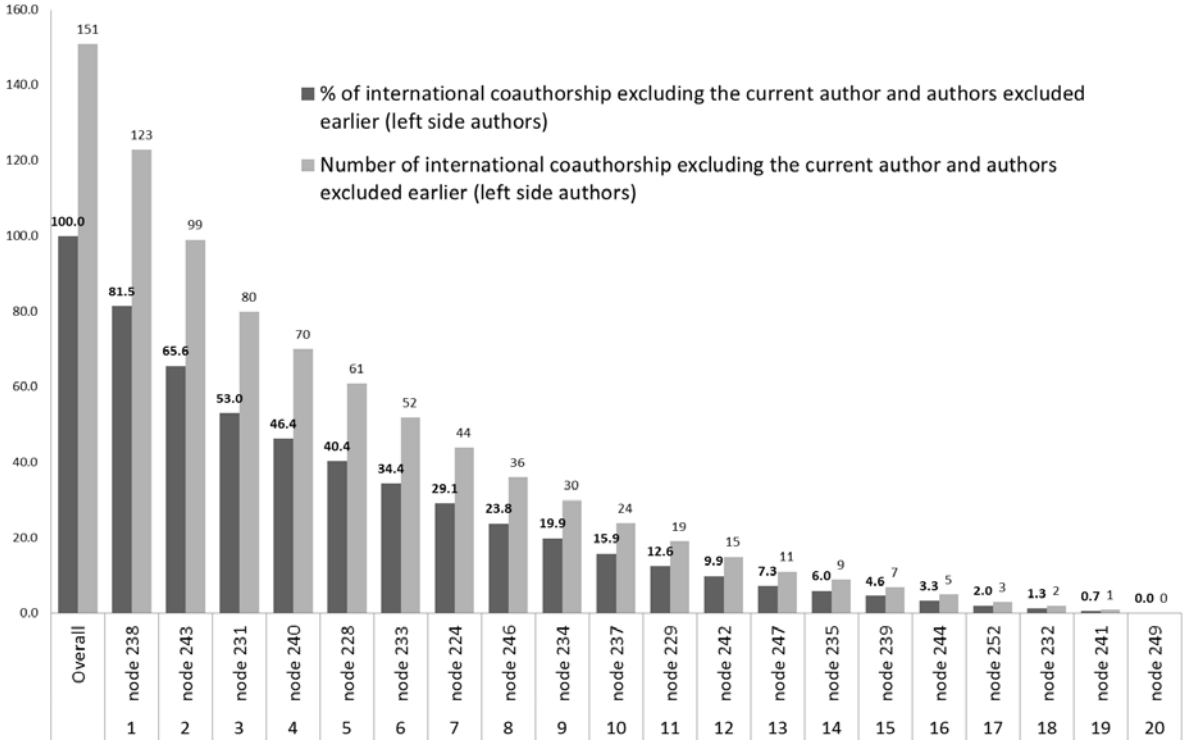

Figure 40. Department of Strategy and Logistics:
International coauthorship based on the sequential faculty members' deletion

5.9 Overall international coauthorship at BI

The number of the overall international coauthorships is equal to 1003. The sorted list of faculty members is represented in Table 20. The deletion of 102 out 252 of (approximately, 40% out of 100%) faculty members will lead to the vanishing of the international coauthorship. It is important to notice that the deletion of only 11 out of 252 faculty members (i.e., approx. 4% out of 100%) will bring almost 50% reduction of the BI international coauthorship.
The given results (in percentage terms) are represented in Figure 41.

Table 20. Overall international coathorship by faculty members at BI

	Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion		Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion
1	node 223	127	876	12.7	87.3	64	node 66	3	66	0.3	6.6
2	node 184	66	810	6.6	80.8	65	node 93	3	63	0.3	6.3
3	node 83	40	770	4.0	76.8	66	node 102	3	60	0.3	6.0
4	node 67	39	731	3.9	72.9	67	node 127	3	57	0.3	5.7
5	node 181	39	692	3.9	69.0	68	node 198	3	54	0.3	5.4
6	node 192	36	656	3.6	65.4	69	node 201	3	51	0.3	5.1
7	node 185	35	621	3.5	61.9	70	node 207	3	48	0.3	4.8
8	node 138	30	591	3.0	58.9	71	node 219	3	45	0.3	4.5
9	node 238	28	563	2.8	56.1	72	node 27	2	43	0.2	4.3
10	node 38	25	538	2.5	53.6	73	node 72	2	41	0.2	4.1
11	node 243	24	514	2.4	51.2	74	node 106	2	39	0.2	3.9
12	node 79	23	491	2.3	49.0	75	node 108	2	37	0.2	3.7
13	node 120	22	469	2.2	46.8	76	node 129	2	35	0.2	3.5
14	node 178	22	447	2.2	44.6	77	node 140	2	33	0.2	3.3
15	node 189	19	428	1.9	42.7	78	node 154	2	31	0.2	3.1
16	node 231	19	409	1.9	40.8	79	node 159	2	29	0.2	2.9
17	node 174	18	391	1.8	39.0	80	node 162	2	27	0.2	2.7
18	node 94	15	376	1.5	37.5	81	node 217	2	25	0.2	2.5
19	node 122	14	362	1.4	36.1	82	node 235	2	23	0.2	2.3
20	node 148	13	349	1.3	34.8	83	node 239	2	21	0.2	2.1
21	node 103	11	338	1.1	33.7	84	node 244	2	19	0.2	1.9
22	node 167	11	327	1.1	32.6	85	node 252	2	17	0.2	1.7
23	node 175	11	316	1.1	31.5	86	node 10	1	16	0.1	1.6
24	node 211	10	306	1.0	30.5	87	node 42	1	15	0.1	1.5
25	node 220	10	296	1.0	29.5	88	node 56	1	14	0.1	1.4
26	node 240	10	286	1.0	28.5	89	node 77	1	13	0.1	1.3
27	node 43	9	277	0.9	27.6	90	node 100	1	12	0.1	1.2
28	node 194	9	268	0.9	26.7	91	node 104	1	11	0.1	1.1
29	node 212	9	259	0.9	25.8	92	node 112	1	10	0.1	1.0
30	node 228	9	250	0.9	24.9	93	node 133	1	9	0.1	0.9
31	node 233	9	241	0.9	24.0	94	node 173	1	8	0.1	0.8
32	node 59	8	233	0.8	23.2	95	node 179	1	7	0.1	0.7
33	node 96	8	225	0.8	22.4	96	node 186	1	6	0.1	0.6
34	node 113	8	217	0.8	21.6	97	node 216	1	5	0.1	0.5
35	node 166	8	209	0.8	20.8	98	node 218	1	4	0.1	0.4
36	node 224	8	201	0.8	20.0	99	node 222	1	3	0.1	0.3
37	node 246	8	193	0.8	19.2	100	node 232	1	2	0.1	0.2
38	node 37	7	186	0.7	18.5	101	node 241	1	1	0.1	0.1
39	node 200	7	179	0.7	17.8	102	node 249	1	0	0.1	0.0
40	node 132	6	173	0.6	17.2	103	node 1	0	0	0.0	0.0
41	node 172	6	167	0.6	16.7	104	node 2	0	0	0.0	0.0
42	node 234	6	161	0.6	16.1	105	node 3	0	0	0.0	0.0
43	node 237	6	155	0.6	15.5	106	node 4	0	0	0.0	0.0
44	node 99	5	150	0.5	15.0	107	node 5	0	0	0.0	0.0
45	node 118	5	145	0.5	14.5	108	node 6	0	0	0.0	0.0
46	node 119	5	140	0.5	14.0	109	node 7	0	0	0.0	0.0
47	node 145	5	135	0.5	13.5	110	node 8	0	0	0.0	0.0
48	node 171	5	130	0.5	13.0	111	node 9	0	0	0.0	0.0
49	node 203	5	125	0.5	12.5	112	node 12	0	0	0.0	0.0
50	node 210	5	120	0.5	12.0	113	node 13	0	0	0.0	0.0
51	node 229	5	115	0.5	11.5	114	node 14	0	0	0.0	0.0
52	node 36	4	111	0.4	11.1	115	node 15	0	0	0.0	0.0
53	node 98	4	107	0.4	10.7	116	node 16	0	0	0.0	0.0
54	node 101	4	103	0.4	10.3	117	node 17	0	0	0.0	0.0
55	node 130	4	99	0.4	9.9	118	node 18	0	0	0.0	0.0
56	node 155	4	95	0.4	9.5	119	node 19	0	0	0.0	0.0
57	node 165	4	91	0.4	9.1	120	node 20	0	0	0.0	0.0
58	node 182	4	87	0.4	8.7	121	node 21	0	0	0.0	0.0
59	node 215	4	83	0.4	8.3	122	node 22	0	0	0.0	0.0
60	node 242	4	79	0.4	7.9	123	node 23	0	0	0.0	0.0
61	node 247	4	75	0.4	7.5	124	node 24	0	0	0.0	0.0
62	node 11	3	72	0.3	7.2	125	node 25	0	0	0.0	0.0
63	node 29	3	69	0.3	6.9	126	node 26	0	0	0.0	0.0

Table 20. *Continued.*

	Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion		Faculty	number of coauthorship	Overall after exclusion	% out of overall coauthorship	Overall % after exclusion
127	node 28	0	0	0.0	0.0	190	node 123	0	0	0.0	0.0
128	node 30	0	0	0.0	0.0	191	node 124	0	0	0.0	0.0
129	node 31	0	0	0.0	0.0	192	node 125	0	0	0.0	0.0
130	node 32	0	0	0.0	0.0	193	node 126	0	0	0.0	0.0
131	node 33	0	0	0.0	0.0	194	node 128	0	0	0.0	0.0
132	node 34	0	0	0.0	0.0	195	node 131	0	0	0.0	0.0
133	node 35	0	0	0.0	0.0	196	node 134	0	0	0.0	0.0
134	node 39	0	0	0.0	0.0	197	node 135	0	0	0.0	0.0
135	node 40	0	0	0.0	0.0	198	node 136	0	0	0.0	0.0
136	node 41	0	0	0.0	0.0	199	node 137	0	0	0.0	0.0
137	node 44	0	0	0.0	0.0	200	node 139	0	0	0.0	0.0
138	node 45	0	0	0.0	0.0	201	node 141	0	0	0.0	0.0
139	node 46	0	0	0.0	0.0	202	node 142	0	0	0.0	0.0
140	node 47	0	0	0.0	0.0	203	node 143	0	0	0.0	0.0
141	node 48	0	0	0.0	0.0	204	node 144	0	0	0.0	0.0
142	node 49	0	0	0.0	0.0	205	node 146	0	0	0.0	0.0
143	node 50	0	0	0.0	0.0	206	node 147	0	0	0.0	0.0
144	node 51	0	0	0.0	0.0	207	node 149	0	0	0.0	0.0
145	node 52	0	0	0.0	0.0	208	node 150	0	0	0.0	0.0
146	node 53	0	0	0.0	0.0	209	node 151	0	0	0.0	0.0
147	node 54	0	0	0.0	0.0	210	node 152	0	0	0.0	0.0
148	node 55	0	0	0.0	0.0	211	node 153	0	0	0.0	0.0
149	node 57	0	0	0.0	0.0	212	node 156	0	0	0.0	0.0
150	node 58	0	0	0.0	0.0	213	node 157	0	0	0.0	0.0
151	node 60	0	0	0.0	0.0	214	node 158	0	0	0.0	0.0
152	node 61	0	0	0.0	0.0	215	node 160	0	0	0.0	0.0
153	node 62	0	0	0.0	0.0	216	node 161	0	0	0.0	0.0
154	node 63	0	0	0.0	0.0	217	node 163	0	0	0.0	0.0
155	node 64	0	0	0.0	0.0	218	node 164	0	0	0.0	0.0
156	node 65	0	0	0.0	0.0	219	node 168	0	0	0.0	0.0
157	node 68	0	0	0.0	0.0	220	node 169	0	0	0.0	0.0
158	node 69	0	0	0.0	0.0	221	node 170	0	0	0.0	0.0
159	node 70	0	0	0.0	0.0	222	node 176	0	0	0.0	0.0
160	node 71	0	0	0.0	0.0	223	node 177	0	0	0.0	0.0
161	node 73	0	0	0.0	0.0	224	node 180	0	0	0.0	0.0
162	node 74	0	0	0.0	0.0	225	node 183	0	0	0.0	0.0
163	node 75	0	0	0.0	0.0	226	node 187	0	0	0.0	0.0
164	node 76	0	0	0.0	0.0	227	node 188	0	0	0.0	0.0
165	node 78	0	0	0.0	0.0	228	node 190	0	0	0.0	0.0
166	node 80	0	0	0.0	0.0	229	node 191	0	0	0.0	0.0
167	node 81	0	0	0.0	0.0	230	node 193	0	0	0.0	0.0
168	node 82	0	0	0.0	0.0	231	node 195	0	0	0.0	0.0
169	node 84	0	0	0.0	0.0	232	node 196	0	0	0.0	0.0
170	node 85	0	0	0.0	0.0	233	node 197	0	0	0.0	0.0
171	node 86	0	0	0.0	0.0	234	node 199	0	0	0.0	0.0
172	node 87	0	0	0.0	0.0	235	node 202	0	0	0.0	0.0
173	node 88	0	0	0.0	0.0	236	node 204	0	0	0.0	0.0
174	node 89	0	0	0.0	0.0	237	node 205	0	0	0.0	0.0
175	node 90	0	0	0.0	0.0	238	node 206	0	0	0.0	0.0
176	node 91	0	0	0.0	0.0	239	node 208	0	0	0.0	0.0
177	node 92	0	0	0.0	0.0	240	node 209	0	0	0.0	0.0
178	node 95	0	0	0.0	0.0	241	node 213	0	0	0.0	0.0
179	node 97	0	0	0.0	0.0	242	node 214	0	0	0.0	0.0
180	node 105	0	0	0.0	0.0	243	node 221	0	0	0.0	0.0
181	node 107	0	0	0.0	0.0	244	node 225	0	0	0.0	0.0
182	node 109	0	0	0.0	0.0	245	node 226	0	0	0.0	0.0
183	node 110	0	0	0.0	0.0	246	node 227	0	0	0.0	0.0
184	node 111	0	0	0.0	0.0	247	node 230	0	0	0.0	0.0
185	node 114	0	0	0.0	0.0	248	node 236	0	0	0.0	0.0
186	node 115	0	0	0.0	0.0	249	node 245	0	0	0.0	0.0
187	node 116	0	0	0.0	0.0	250	node 248	0	0	0.0	0.0
188	node 117	0	0	0.0	0.0	251	node 250	0	0	0.0	0.0
189	node 121	0	0	0.0	0.0	252	node 251	0	0	0.0	0.0

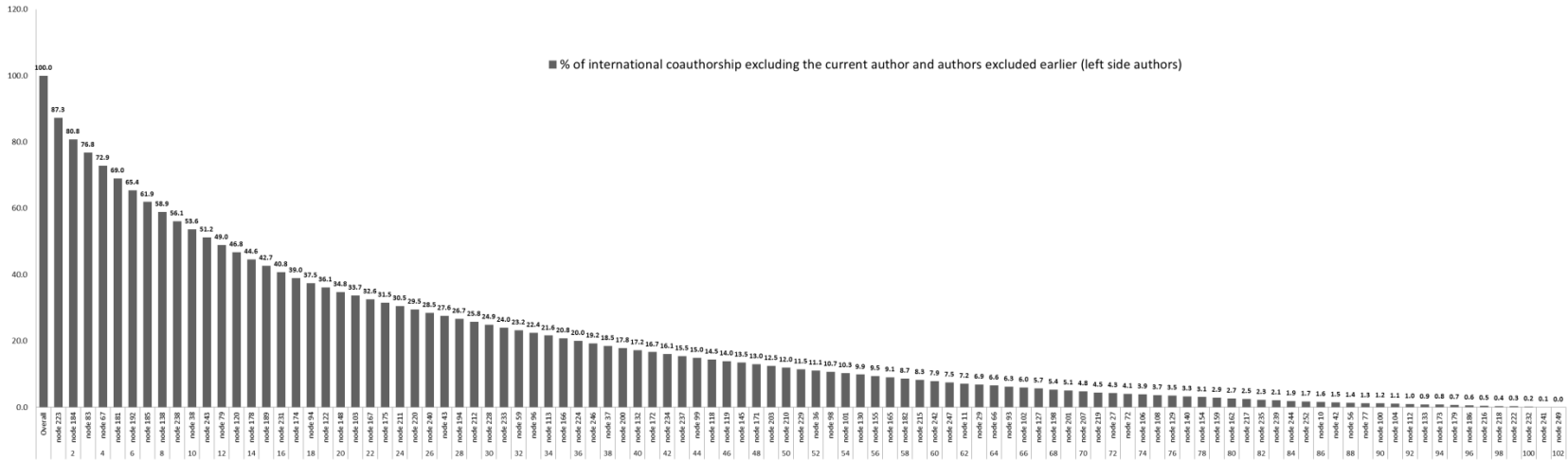

Figure 41. Overall BI international coauthorship based on the sequential faculty members' deletion

6. THE PUBLICATIONS-BASED ANALYSIS

In this section we analyze the research activity of the BI faculty members in terms of the publications indexed by *the ISI Web of Science.* Initially, we extracted the faculty members that have at least 20 publications and sorted them in the descending order. Next, we start to delete the faculty members from the sorted list one by one in order to track the overall research contribution of the most published faculty members. The results are represented in Table 21 and in Figure 42.

The number of publications of all BI faculty members is equal to 1295. Based on the results represented in Table 21 and in Figure 42 we detected that the deletion of persons, who have at least 20 publications, will bring 40% reduction of the overall BI faculty member's publications. Specifically, the deletion of 16 out of 252 (approximately, 6% out of 100%) faculty members will lead to the vanishing of 40% of publications.

Table 21. Overall publications by faculty members at BI

	Faculty	number of publications	Overall after exclusion	% out of overall publications	Overall % after exclusion
1	node 166	70	1225	5.4	94.6
2	node 223	59	1166	4.6	90.0
3	node 100	42	1124	3.2	86.8
4	node 83	38	1086	2.9	83.9
5	node 185	38	1048	2.9	80.9
6	node 184	29	1019	2.2	78.7
7	node 67	28	991	2.2	76.5
8	node 138	28	963	2.2	74.4
9	node 171	28	935	2.2	72.2
10	node 180	27	908	2.1	70.1
11	node 181	25	883	1.9	68.2
12	node 148	23	860	1.8	66.4
13	node 120	22	838	1.7	64.7
14	node 131	21	817	1.6	63.1
15	node 94	20	797	1.5	61.5
16	node 43	20	777	1.5	60.0

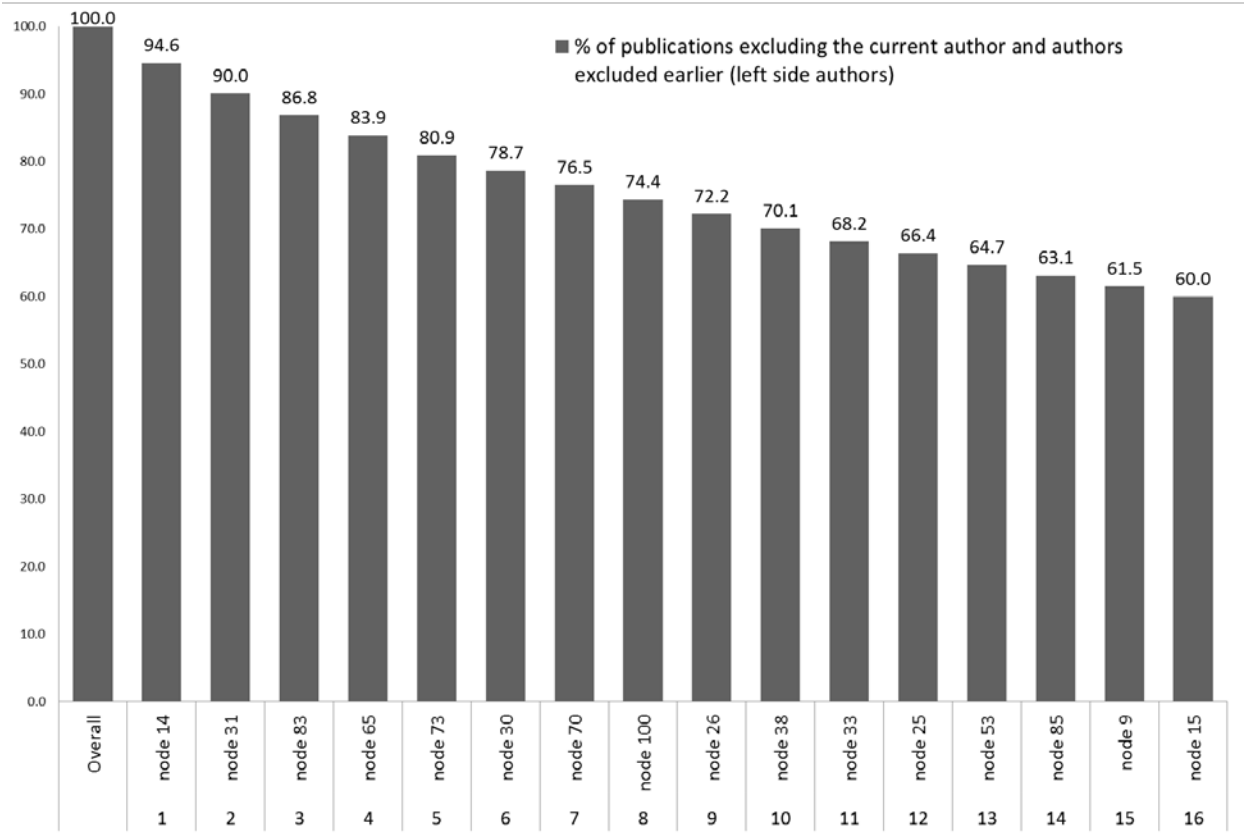

Figure 42. Overall BI publications based on the sequential deletion of the faculty members who have at least 20 publications registered in *the ISI Web of Science*

7. CONCLUSION

In the given research we constructed the BI coauthorship network based on the information retrieved from *the ISI Web of Science*. We analyzed the publications in the period 1950 – Spring, 2014 for the current BI faculty members. The results were represented in tabular and graphical formats. First, we showed the departmental, interdepartmental and external publications for each faculty member. The diversified representation of the overall coauthorship was combined with the information regarding the number of publications done by each faculty member.

Next, we analyzed the strongly connected research groups (i.e., cliques) on the interdepartmental level. The importance of this analysis is based on the necessity of detection and clear representation of the research groups and their interactions between each other. The analysis of spanning trees and forests helped to visualize the spread of the research interests by the faculty members from different departments over the whole BI coauthorship network. In fact, we draw the clear picture of how faculty members from different departments are connected to each other in the diversified "chains" of varying research interests.

We analyzed the international coauthorship for every department separately and for the overall BI without splitting the faculty members according to their departments' affiliations. Based on this analysis we made the representation of the faculty members' international relations (based on *the ISI Web of Science*). Also, it helped to detect the groups of faculty members that make the most contribution to the BI's international research collaboration.

Finally, we analyzed the research activity of the BI faculty members based on the number of publications registered in *the ISI Web of Science.*

It is important to notice that the results regarding the publications counted in the given research were retrieved in the different periods of Spring, 2014. This is due to the fact that the process of extraction, filtering and systemizing of the required information is time consuming. Therefore, we would like to specify that the retrieved information could be updated and changed since its last extraction. Also, we would like to note that the detailed information in tabular format is available upon request.

We assume that the given research might be helpful for understanding of what is done by BI faculty members in terms of the scientific research. However, since we have used only one source, *the ISI Web of Science*, the analysis should be complemented by the use of other sources such as *SCOPUS* and *Google Scholar* to get a more complete view of the scientific research activities of the BI faculty. In order to make such an analysis doable all BI faculty members must be registered in *Google Scholar* with an open profile. In order to use an analysis of this type as a tool for the further planning of BIs research activities and as a tool for strategic development the registrations of research activities should be updated on a regular basis.

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