THE SHIFT OF CYBERNETICS FROM THE US TO EUROPE

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A brief history of cybernetics

- Created in the U.S. during and after World War II
- Many key scientists were from Europe
- When they died, cybernetics research shifted back to Europe
- Cybernetics research has declined in the U.S. but is growing in Europe

The importance of cybernetics

- Whereas physics is a general theory of matter and energy relationships, cybernetics is a general theory of information-processing and decision-making
- Cybernetics can be viewed as the foundation of the social sciences in somewhat the same way that physics is the foundation of the engineering disciplines

Why cybernetics prospers in Europe

- Americans and Europeans look for meaning in different directions
- Americans reason "down" to find meaning in examples and applications
- Europeans reason "up" to find meaning in larger categories or social context
- Hence, Europeans see general theories as important and useful. Americans tend not to

Test the hypothesis

- To test the hypothesis that there has been a shift of cybernetics research to Europe, we looked at the lead authors of articles in the journal *Cybernetics and Systems* from 1988 to 2007 in five year intervals
- Table 1 shows the number of articles from each country
- Table 2 groups the countries into regions

Country	1988	1992	1997	2002	2007
Argentina	0	0	0	2	0
Australia	0	0	2	2	5
Austria	1	0	2	1	0
Bulgaria	0	1	1	0	0
Canada	3	1	1	1	0
Chile	0	0	0	0	1
China	3	1	3	3	2
Croatia	0	0	0	0	1
Czech Republic / Slovakia	0	3	0	0	0
France	0	0	2	1	1
Germany	0	3	3	0	2
Greece	0	2	0	0	0
India	0	0	1	0	3
Iran	0	0	0	0	1
Israel	1	2	0	0	1
Italy	2	1	1	0	2
Japan	0	0	2	1	1
Jordan	0	0	0	1	0
Mexico	0	0	0	1	0
New Zealand	0	0	0	0	1
Norway	0	1	0	0	0
Oman	0	0	0	1	0
Poland	0	0	0	2	4
Russia	0	0	0	1	0
Serbia	0	0	1	0	0
Singapore	1	0	1	1	0
Slovenia	0	0	1	0	1
Spain	1	10	1	4	3
Sweden	0	0	0	0	2
Switzerland	1	0	0	1	0
Taiwan	0	3	2	8	3
Turkey	0	0	0	0	1
UAE	0	0	0	1	0
UK	1	1	2	5	2
USA	7	7	7	1	3
Yugoslavia	0	1	0	0	0

Table 1. Number of articles per volume and per country ("Cybernetics and Systems" journal)

Area	Symbol	Countries
Asia	А	Australia, China, India, Japan, New Zealand, Singapore, Taiwan
Europe	E	Austria, Bulgaria, Croatia, Czech Republic, France, Germany, Greece, Italy, Norway, Poland, Russia, Serbia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, Yugoslavia
Latin America	LA	Argentina, Chile, Mexico
Middle East	ME	Iran, Israel, Jordan, Oman, Turkey, United Arab Emirates
North America	NA	Canada, United States of America

Table 2. Countries grouped by region ("Cybernetics and Systems" journal)

Testing the hypothesis

- Table 3 shows the number of articles from each region in each of the 5 years chosen
- Figure 1 shows a graph of the number of articles by region
- Table 4 shows the percentage increase or decrease for each region from 1988 to 2007

Area	Symbol	1988	1992	199 7	2002	2007
Asia	А	4	4	11	15	15
Europe	E	6	23	14	15	18
Latin America	LA	0	0	0	3	1
Middle East	ME	1	2	0	3	3
North America	NA	10	8	8	2	3

Table 3. Number of articles per volume and per region ("Cybernetics and Systems" journal)



Area	Symbol	1988	2007	Change	% Change
Asia	А	4	15	+11	+275%
Europe	Е	6	18	+12	+200%
Latin America	LA	0	1	+1	N/A
Middle East	ME	1	3	+2	+200%
North America	NA	10	3	-7	-70%

Table 4. Activity changes between 1988 and 2007 in absolute value and percentage("Cybernetics and Systems" journal)

Results of test of hypothesis

- In the journal *Cybernetics and Systems* North America was the leading contributor to cybernetics research in 1988
- Europe was second, Asia third, the Middle East fourth and Latin America fifth
- In 2007 Europe was first and Asia second
- N. America and the Middle East were tied for third and Latin America was fourth

Further tests of the hypothesis

To further test the hypothesis that there has been a shift of cybernetics research to Europe, we looked at the nationalities of the lead authors of articles in two additional journals: *Kybernetes* and *System Research and Behavioral Science*

"Kybernetes" journal

- We looked at a second journal, *Kybernetes*, from 1974 to 2010 in three year intervals
- Table 5 groups the countries into regions
- Table 6 shows the number of articles per volume and per country
- Table 7 shows the number of articles per volume and per region
- Figure 2 shows the number of articles per volume and per region over time
- Table 8 shows the percentage increase or decrease for each region from 1974 to 2010

Table 5. Countries grouped by region

Area	Countries
Asia	Bangladesh, China, India, Indonesia, Japan, Korea, Singapore, Taiwan
Europe	Austria, Belarus, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Finland, France, Georgia, Germany, Greece, Ireland, Italy, Lithuanian, Netherlands, Norway, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, Yugoslavia
Latin	Argentina, Chile, Colombia, Mexico
America	
Middle East	Algeria, Iran, Israel, Jordan, Morocco, Pakistan, Saudi Arabia
North	Canada, United States of America
America	
Oceania	Australia, New Zealand
Africa	Kenya, South Africa

Country Algeria Australia Austria Bangladesh Belarus Belgium Brazil Bulgaria Canada Chile China Colombia Czech Republic Denmark Finland France Georgia Germany Greece India Indonesia Iran Ireland Israel Italy Japan Jordan

Table 6. Number of articles per volume and per country ("Kybernetes" journal)

Korea								2					
Kenya								2					
Lithuanian	1												
Morocco	1												
Netherlands				1			1	1		5	1	1	
Norway		1							1				1
Pakistan											1		
Poland			2		3			1		2	1	1	1
Portugal												1	
Romania	4	1	1		1	1	1	1		1			
Russia		1			1			1				3	
Saudi													
Arabia					1	1							
Slovakia													1
Slovenia											1	3	2
South Africa		1									1	1	
Spain			1	1	2	2	1	2	2	1	4	8	2
Sweden									3	2		2	
Switzerland	2	1					1			3	1	4	2
Taiwan													5
Turkey											1	1	2
UK	1	3	6	1	3	7	10	4	11	27	19	26	20
Ukraine	1	1											
USA	11	8	5	7	5	3	6	14	8	14	14	19	7
Yugoslavia		1							1				

	1974	1977	1980	1983	1986	1989	1992	1995	1998	2001	2004	2007	2010
Asia	2	3	1	3	4	1	0	8	14	10	37	8	49
Europe	15	16	21	13	15	13	22	13	27	48	34	72	38
Latin America	0	0	1	1	0	0	0	2	0	0	3	4	2
Middle East	1	1	0	0	1	3	0	2	3	4	2	0	0
North America	12	9	8	9	6	4	9	21	10	17	18	21	10
Oceania	0	0	0	0	0	0	0	0	0	0	0	4	0
Africa	0	1	0	0	0	0	0	2	0	2	2	2	1

Table 7. Number of articles per volume and per region ("Kybernetes" journal)



Figure 2. Articles per volume by region over time ("Kybernetes" journal)

Area	1974	2010	Change	% Change
Asia	2	49	+47	+2350%
Europe	15	38	+23	+153%
Latin America	0	2	+2	N/A
Middle East	1	0	-1	-100%
North America	12	10	-2	-16%
Oceania	0	0	0	0
Africa	0	1	+1	N/A

Table 8. Activity changes between 1974 and 2010 in absolute value and percentage ("Kybernetes" journal)

"Systems Research and Behavioral Science" journal

- We then looked at a third journal, Systems Research and Behavioral Science, from 1998 to 2010 in three year intervals
- Table 9 shows the number of articles per volume and per country
- Table 10 shows the number of articles per volume and per region
- Figure 3 shows the number of articles per volume and per region over time
- Table 11 shows the percentage increase or decrease for each region from 1998 to 2010

Country	1998	2001	2004	2007	2010
Argentina	1		1		
Australia	6		1	7	5
Austria				1	2
Belgium				1	
Brazil		1			2
Bulgaria			1		
Canada					1
Chile			1		2
China				5	6
Colombia			2	1	
Cyprus		1			
Denmark		1			
Finland					1
Germany			3		
Greece	1			1	1
India	1	2			
Israel		1	2		1

Table 9. Number of articles per volume and per country ("Systems Research and Behavioral Science" journal)

Italy	1			1	1
Japan		1	2	1	1
Korea	1				
Mexico			1	1	3
Netherlands		1		2	1
New Zeland	1			4	1
Norway					1
Portugal					1
Russia			1		
Slovenia				1	2
South Africa	1				
Spain		1			
Sweden	2	6			
Switzerland		1	2		
Taiwan					2
Turkey			1		
UK	9	4	7	9	5
USA	10	10	15	10	3

	1998	2001	2004	2007	2010
Asia	2	3	2	6	9
Europe	13	15	15	16	15
Latin America	1	1	5	2	7
Middle East	0	1	2	0	1
North America	10	10	15	10	4
Oceania	7	0	1	11	6
Africa	1	0	0	0	0

Table 10. Number of articles per volume and per region ("Systems Research and Behavioral Science" journal)



Figure 3. Articles per volume by region over time ("Systems Research and Behavioral Science" journal)

Area	1998	2010	Change	% Change
Asia	2	9	+7	+350%
Europe	13	15	+2	+15%
Latin America	1	7	+6	+6%
Middle East	0	1	+1	N/A
North America	10	4	-6	-60%
Oceania	7	6	-1	-14%
Africa	1	0	-1	-1%

Table 11. Activity changes between 1988 and 2010 in absolute value and percentage ("Systems Research and Behavioral Science" journal)

Combination of data from both journals

- Table 12 shows the number of articles per volume and per country for both journals
- Table 13 shows the number of articles per volume and per region
- Figure 4 shows the number of articles per volume and per region over time
- Table 14 shows the percentage increase or decrease for each region from 1974 to 2010 for both journals

Country	1974	1977	1980	1983	1986	1989	1992	1995	1998	2001	2004	2007	2010
Algeria										2	1	1	1
Argentina									1		1		
Australia									6		1	11	5
Austria			2	1								3	4
Bangladesh									1				
Belarus												1	
Belgium										2		1	
Brazil			1	1				2		1		3	2
Bulgaria	1	2									1		
Canada	1	1	3	2	1	1	3	7	2	3	4	2	4
Chile											1		3
China					2	1		4	10	7	35	7	49
Colombia											5	2	1
Cyprus										1			
Czech													
Republic	1		2										
Denmark										1		2	
Finland						1		1	2	1		1	1
France	1	1	3	4	3	1	7	2	5	2	5	1	1
Georgia	1		1										
Germany	1	3	2	1		1	1			2	4	6	3
Greece				3	1				2			4	2
India		1		2	1			1	3	4	1	4	
Indonesia	2												
Iran									1			2	1
Ireland			1									2	
Israel		1				2		2	3	5	4		1

Table 12. Number of articles per volume and per country

Italy	1	1		1	1				2			5	1
Japan		2	1	1	1			1		1	2	1	1
Jordan										1			
Korea								2	1				
Kenya								2					
Lithuanian	1												
Mexico											1	1	3
Morocco	1												
Netherlands				1			1	1		6	1	3	1
New Zeland									1			4	1
Norway		1							1				2
Pakistan											1		
Poland			2		3			1		2	1	1	1
Portugal												1	1
Romania	4	1	1		1	1	1	1		1			
Russia		1			1			1			1	3	
Saudi													
Arabia					1	1							
Slovakia													1
Slovenia											1	4	4
South Africa		1							1		1	1	
Spain			1	1	2	2	1	2	2	2	4	8	2
Sweden									5	8		2	
Switzerland	2	1					1			4	3	4	2
Taiwan													7
Turkey											2	1	2
UK	1	3	6	1	3	7	10	4	20	31	26	35	25
Ukraine	1	1											
USA	11	8	5	7	5	3	6	14	18	24	29	29	10
Yugoslavia		1							1				

	1974	1977	1980	1983	1986	1989	1992	1995	1998	2001	2004	2007	2010
Asia	2	3	1	3	4	1	0	8	16	13	39	14	58
Europe	15	16	21	13	15	13	22	13	40	63	49	88	53
Latin America	0	0	1	1	0	0	0	2	1	1	8	6	9
Middle East	1	1	0	0	1	3	0	2	3	5	4	0	1
North America	12	9	8	9	6	4	9	21	20	27	33	31	14
Oceania	0	0	0	0	0	0	0	0	7	0	1	15	6
Africa	0	1	0	0	0	0	0	2	1	2	2	2	1

Table 13. Number of articles per volume and per region

Figure 4. Articles per volume by region over time



Area	1974	2010	Change	% Change
Asia	2	58	+56	+2800%
Europe	15	53	+38	+253%
Latin America	0	9	+9	N/A
Middle East	1	1	0	0
North America	12	14	+2	+16%
Oceania	0	6	+6	N/A
Africa	0	1	+1	N/A

Table 14. Activity changes between 1974 and 2010 in absolute value and percentage

Results of the further test of the hypothesis

- In these two additional journals North America continues to fall behind Europe in producing articles in the field of cybernetics
- Asia rises strongly in recent years and appears likely to overtake Europe

Implications of the shift of cybernetics research

- Since cybernetics provides a general theory of information processing and regulation, it can help to guide the creation of information societies
- Reflexivity, a concept central to cybernetics, is used in explanations of boom and bust cycles
- Cybernetics provides a theory of regulation, for example management of a business firm or regulation of business by government or regulation of an international financial system

An increasing need for systems thinking

- Several current trends are reminding people of the need for systems thinking
 - Climate change
 - The financial crisis
 - Continued population growth
 - Resource depletion
- Cybernetics and systems theory provide theories for understanding multi-disciplinary problems

Recommendations for science policy

- To aid in creating an expanded theory of communication and adaptation, support for cybernetics research in the U.S. could be resumed
- Educational programs to teach cybernetics could be established at several universities in a way that is sustainable in discipline-oriented universities

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