Adoption of Digital Information Network Technology by Public Sector Service Organizations in Europe

By

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1. Motivations and Background

A neglected but important empirical subject:

-- Diffusion of internet connectivity in businesses and households has been studied; less is known about network technology acquisition by public service organizations (PSOs) – especially in Europe.

-- PSO's are unlikely to respond very differently than businesses in adopting and deploying the available network technologies, for both recruit ITmanagers from the same professional pools. Our ability to studying PSO experience in greater detail may illuminate more general organizational behaviors.

-- Technology acquisition alone doesn't alter organizational performance with regard to task productivity or service quality provided customers and clients. But detailed description organizations' changing technology profiles is a obvious first step toward understanding of cross-sectional and temporal changes in their performance.

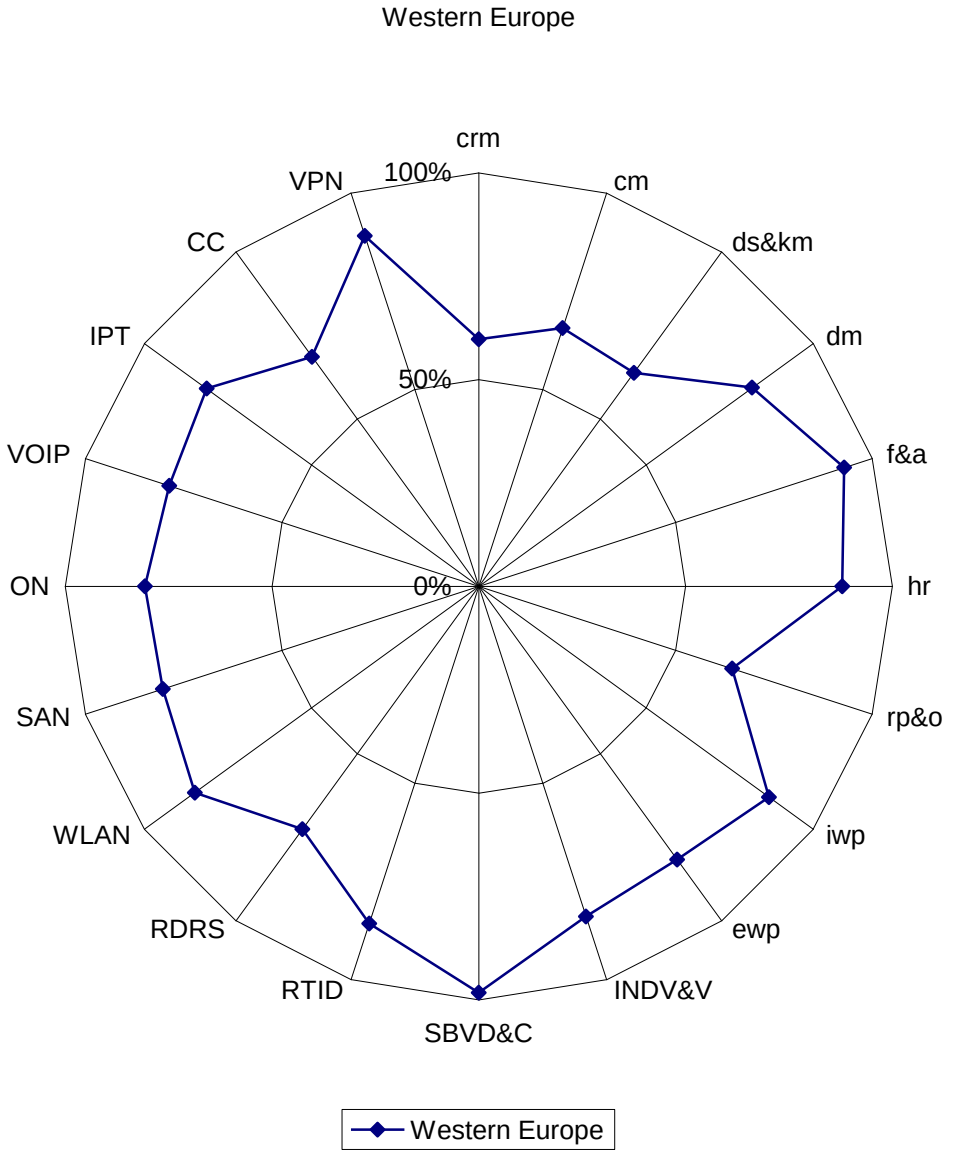
2. **Describing micro-structures in the acquisition of *DINT*:** How do functional priorities and technical complementarities affect the timing and configuration of new technologies?

   2.1 Describing regional and country-wide measures of the extent of diffusion

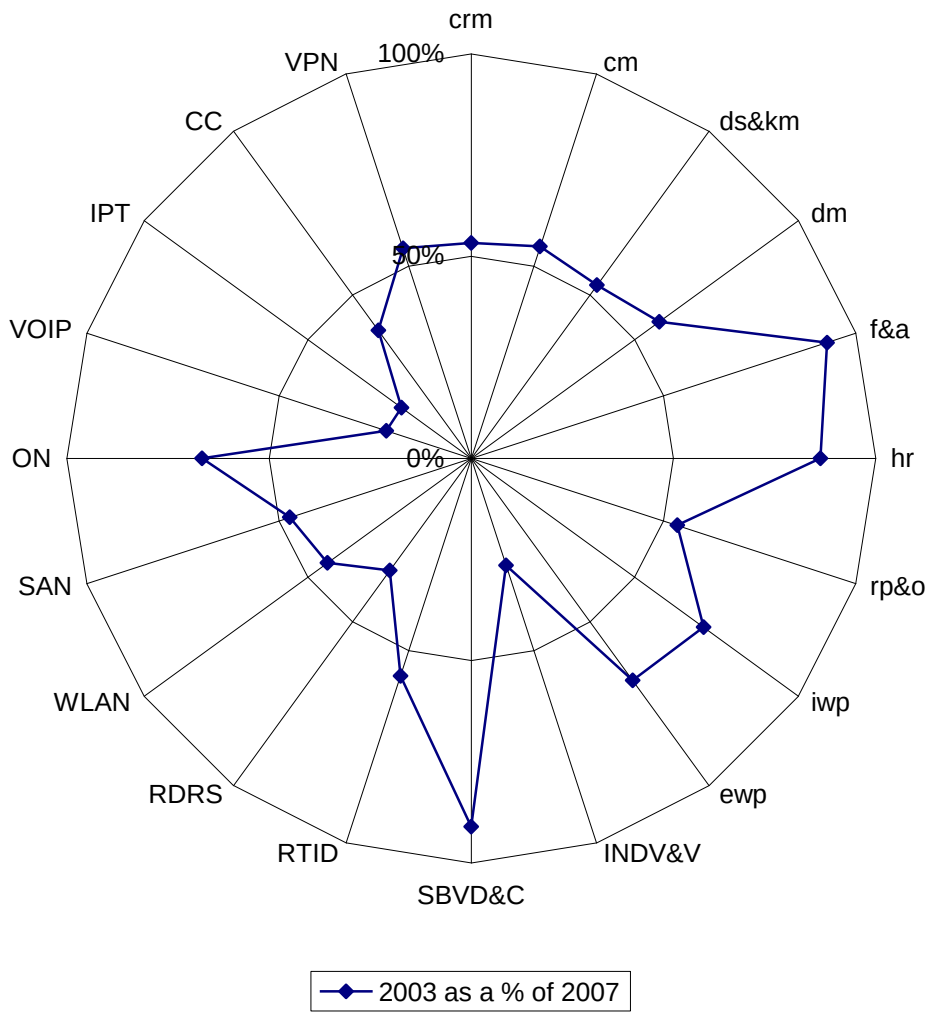
   2.2 Describing the penetration of related grouping of network services and networked applications

Employment-weighted technology-specific penetration rates in the 7-country Western European Region c. 2007

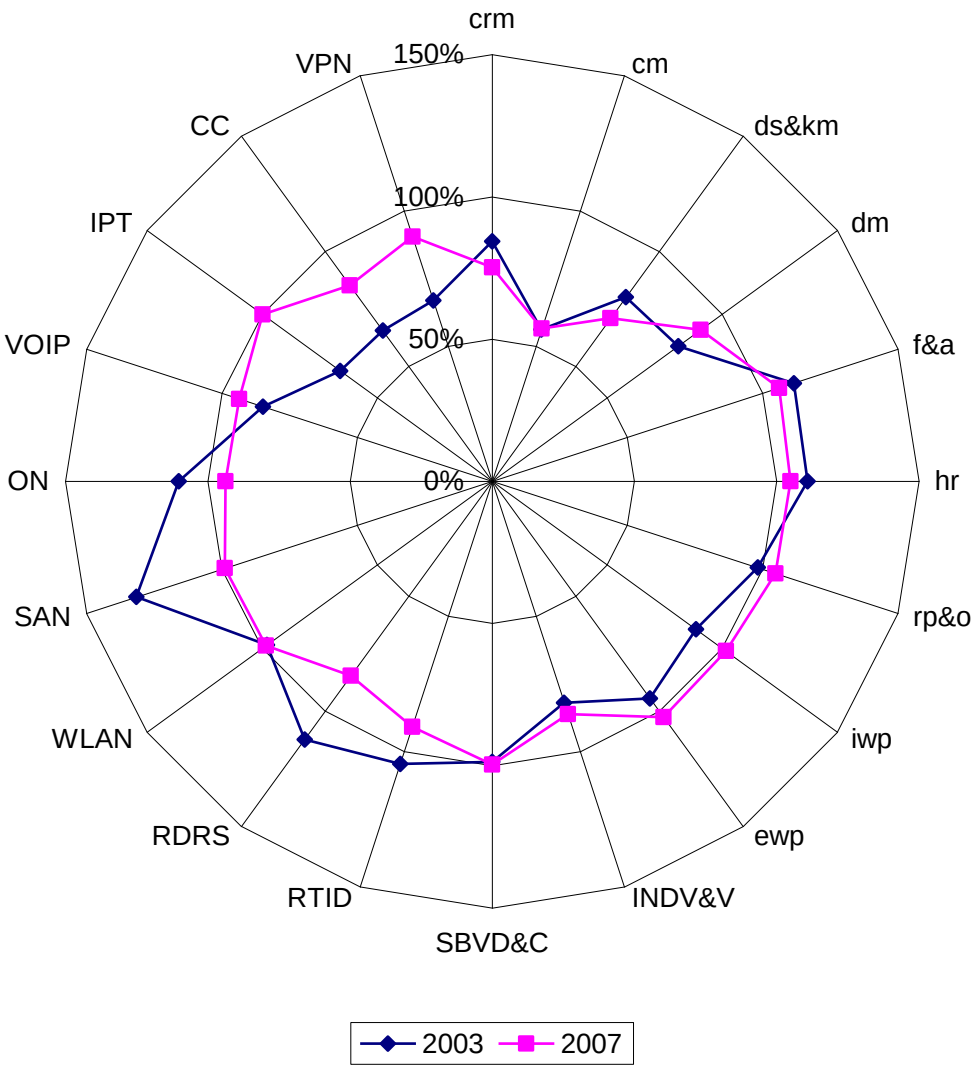
Network services
1. INDV&V – Integrated network for data, voice and video
2. SBVD&C - Server-based virus detection and containment
3. RTID – Real-time intrusion detection
4. RDRS – Remote disaster recovery sites
5. WLAN - Wireless LAN
6. SAN - Storage area networks
7. ON - Optical networking
8. VOIP - Voice over Internet protocol
9. IPT - Internet protocol telephony
10. CC - Content caching
11. VPN - Virtual private networks
Networked applications
1. crm – Customer or citizen relationship management
2. cm - Content management
3. ds&km – Decision support and knowledge management
4. dm - Document management
5. f&a - Finance and accounting
6. hr - Human resources
7. rp&o - Resource planning and optimization
8. iwp - Internal web portals
9. ewp - External web portals



Employment-weighted technology-specific penetration rates for Western Europe: 2003 rate as percentage of 2007 ratel



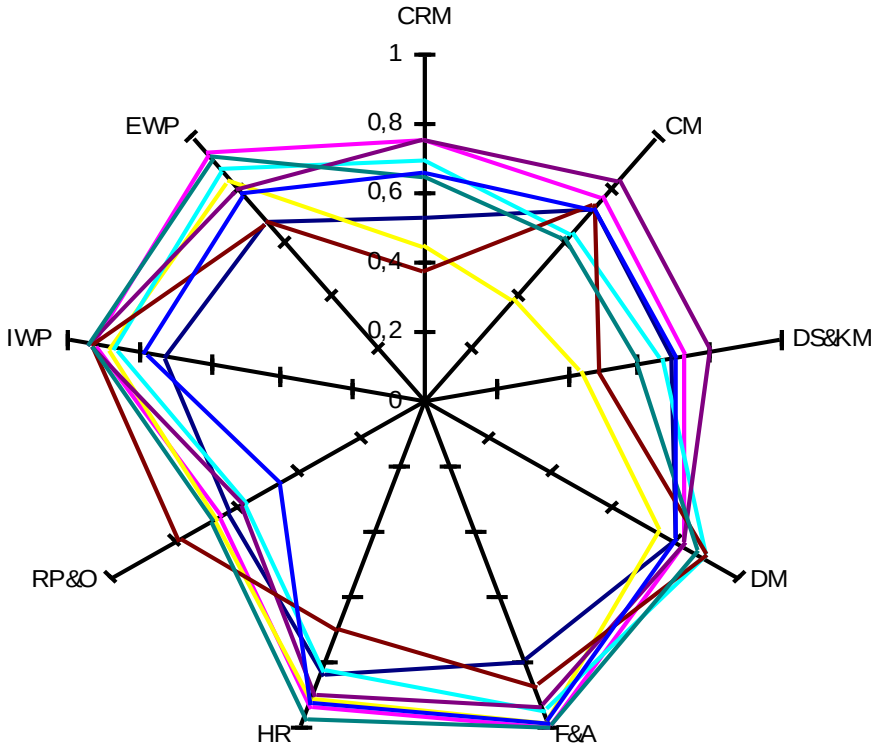
Employment-weighted technology-specific penetration rates: France compared with Western Europe, in 2003 and c.2007



National penetration rates c.2007: 9 applications

employment-weighted aggregates of all organizations

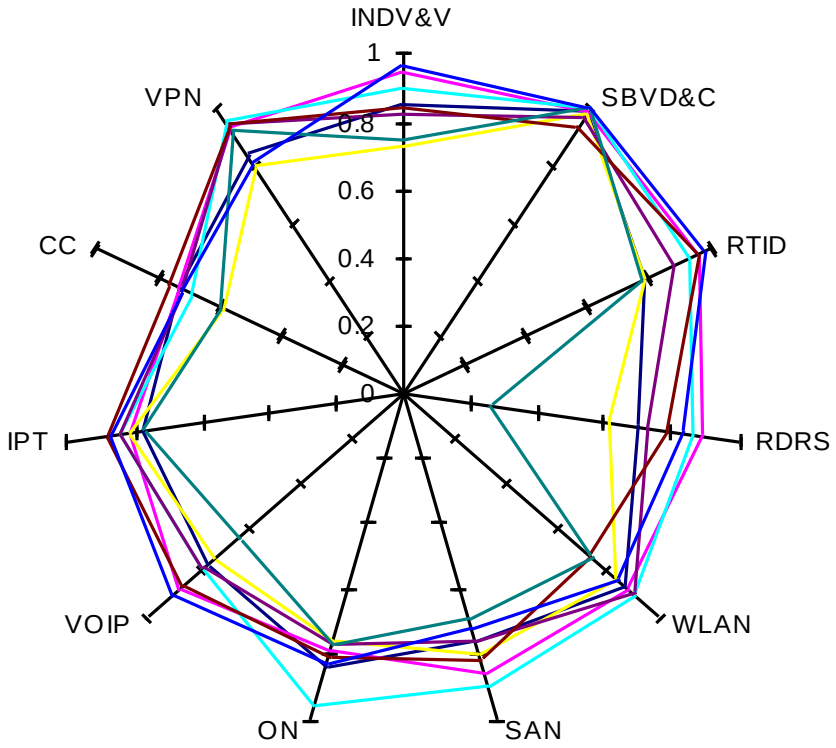
France and Poland tend to lag the others



National penetration rates c.2007: 11 services

employment-weighted aggregates of all organizations

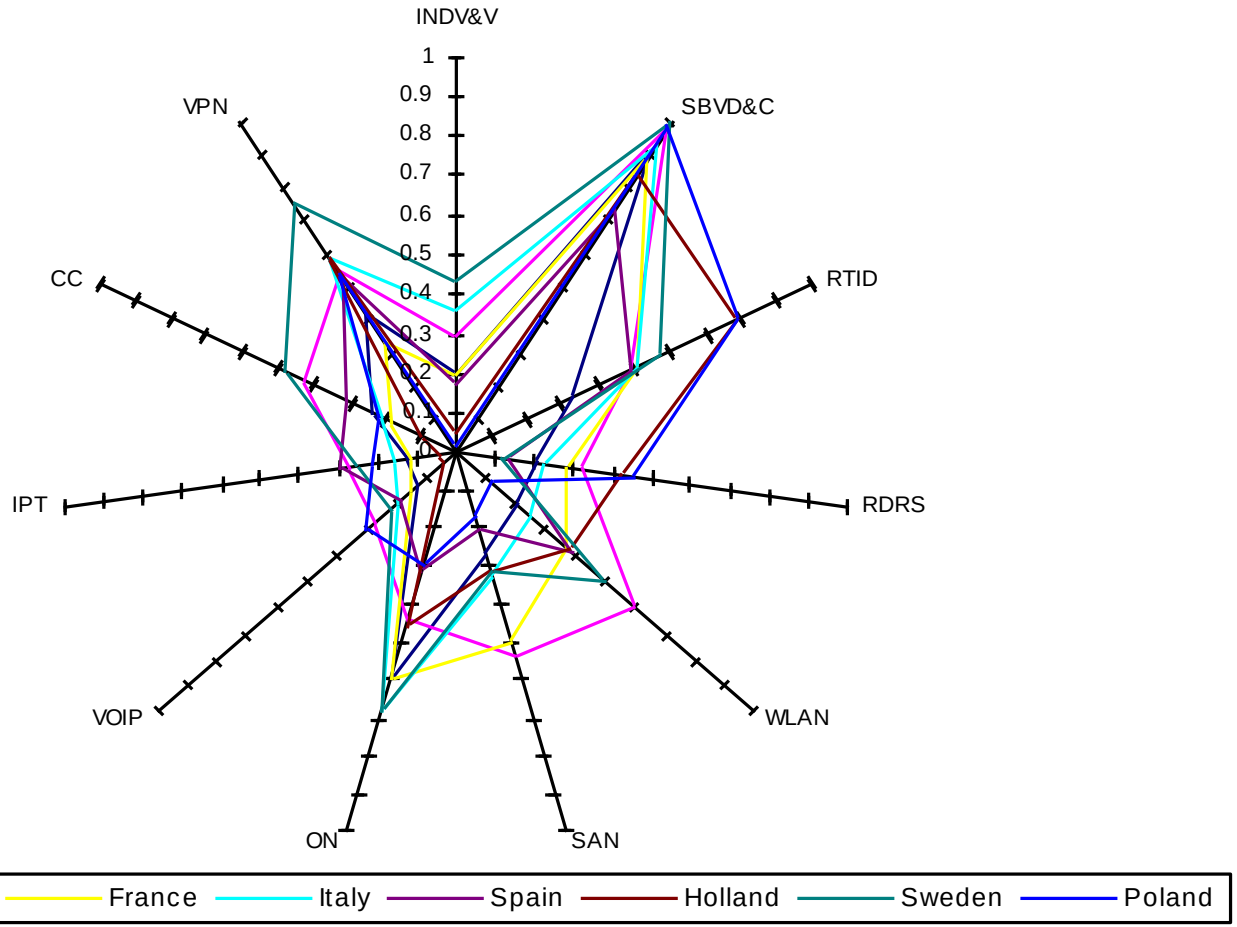
France and Poland tend to lag the others



National penetration rates in 2003: 11 services

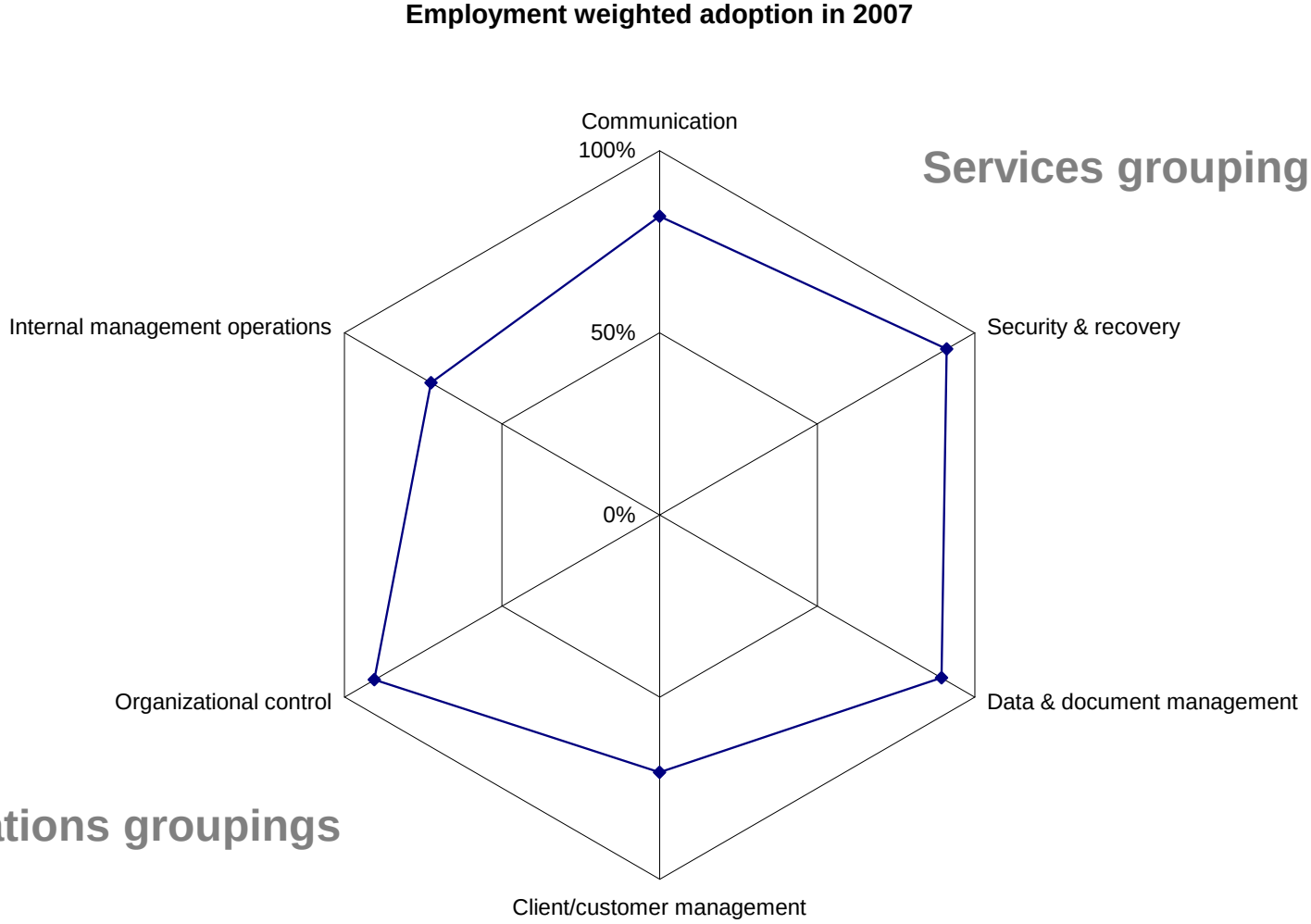
employment-weighted aggregates of all organizations

rank–standings in the early extent of diffusion were more dis-ordered



3.1 Employment-weighted penetration rates in Western Europe's PSOs of functional groupings" of services and applications technologies

Employment-weighted extent of diffusion in W.Europe c.2007: averages for 6 functional groupings



Assignment of network services to «functional groupings»

	Functional groupings		
	Commun-ication	Security	Data & Doc management
Network services			
1. INDV&V – Integrated network for data, voice and video	x		
2. SBVD&C - Server-based virus detection and containment		x	
3. RTID – Real-time intrusion detection		x	
4. RDRS – Remote disaster recovery sites			x
5. WLAN - Wireless LAN	x		
6. SAN - Storage area networks			x
7. ON - Optical networking	x		
8. VOIP - Voice over Internet protocol	x		
9. IPT - Internet protocol telephony	x		
10. CC - Content caching			x
11. VPN - Virtual private networks		x	

Assignment of applications to «functional groupings»

	Functional groupings		
	Client / Customer management	**Organiz-ational control**	**Internal management operations**
Networked applications			
1. CRM – Customer or citizen relationship management	X		
2. CM - Content management			X
3. DS&KM – Decision support and knowledge management			X
4. DM - Document management			X
5. F&A - Finance and accounting		X	
6. HR - Human resources		X	
7. RP&O - Resource planning and optimization			X
8. IWP - Internal web portals			X
9. EWP - External web portals	X		

3.2 Employment-weighted penetration rates in Western Europe's PSOs of "techno-clusters" of services and applications technologies

3.2.1 Are there a few major "techno-clusters" in the micro-level structure of DINT acquistion among public service organizations (PSOs)?

-- to find them would be useful as a data compression device that is based on organizational behaviors, rather than the *a priori* groupings of technologies on the basis of their engineering functionalities…

-- and, if the techno-clusters were to be stable (or quasi-stable) it would be especially useful in concisely characterizing diffusion patterns

A methodology for identifying "*techno-clusters"* in the PSOs' IT acquisitions-- as of 2003, and c.2007

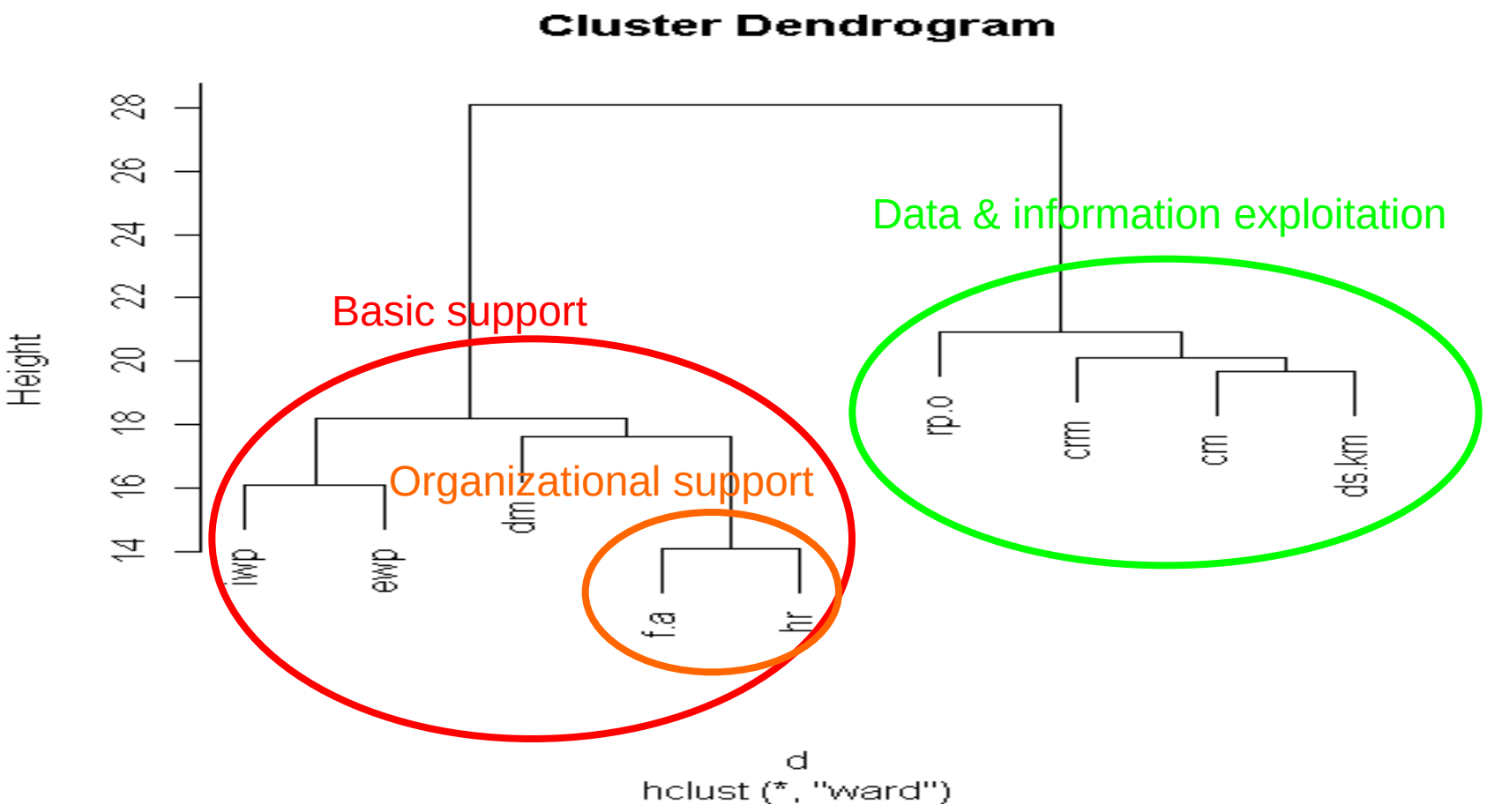
i) for each date form technology-specific vectors of the adoption status of (a) each of the services, and (b) the applications, and of (c) all technologies together – using the survey observations for the entire SPO population;

ii) for each observation date, calculate Euclidian distances between these vectors;

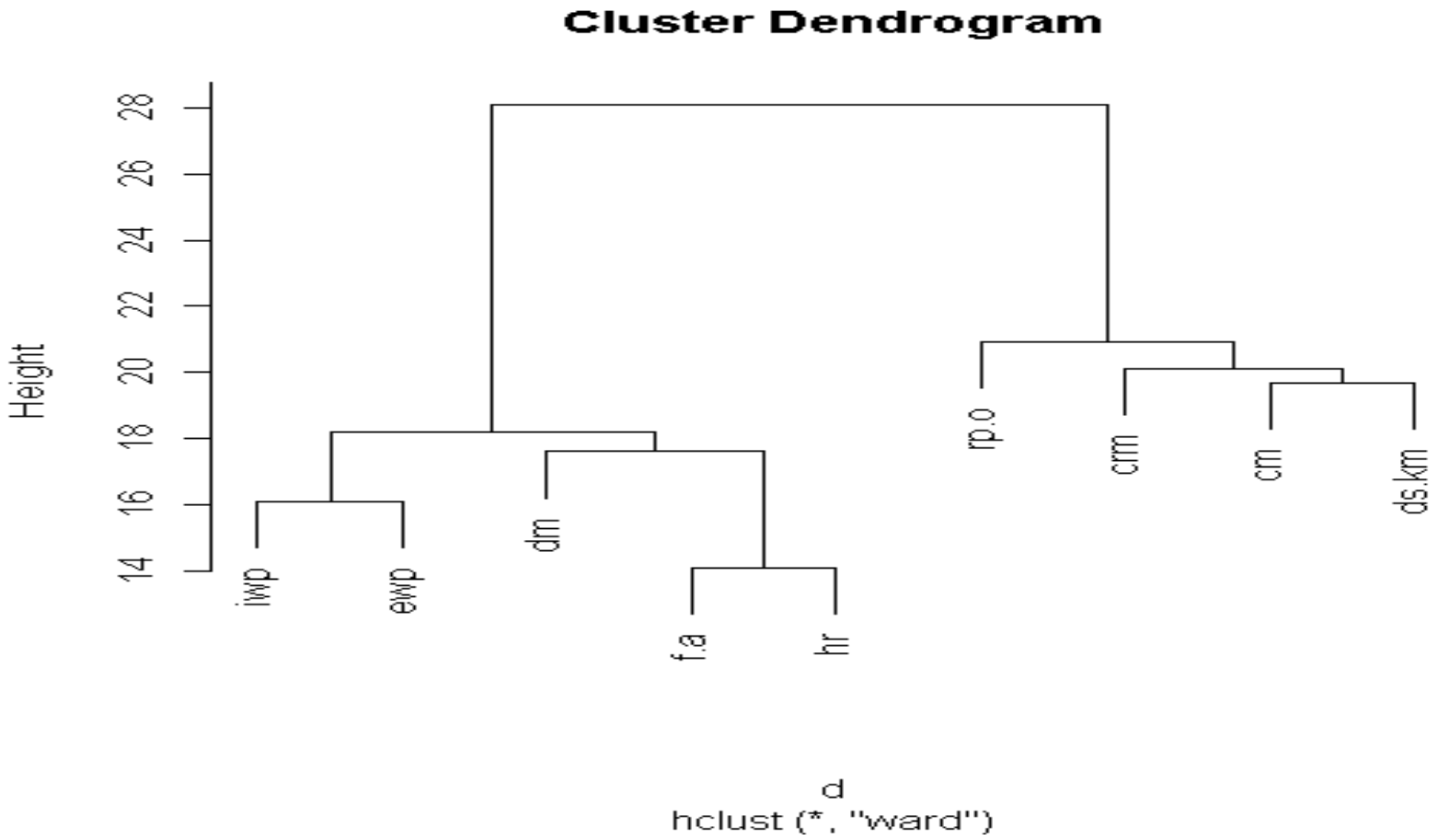
iii) find the set of services-vectors, and the set of applications-vectors between which the distances are large, and use those numbers to perform hierarchical ascending clustering.

iv) clustering based on observations for 2003, and repeated for 2007, yields 2 major "applications techno-clusters" and 2 major "services techno-clusters" for each of those dates.

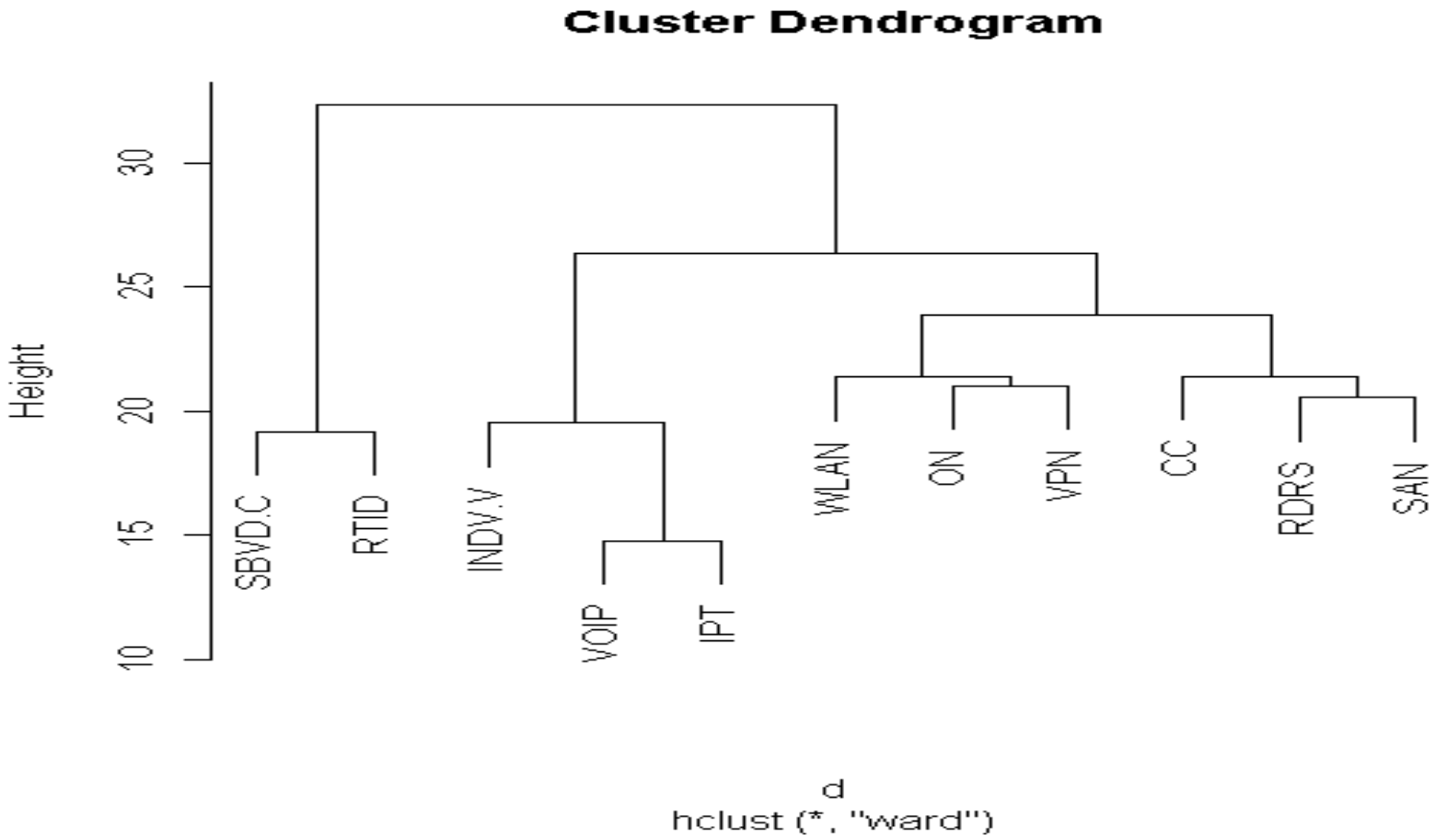
2 techno-clusters of applications and services: observations c.2003



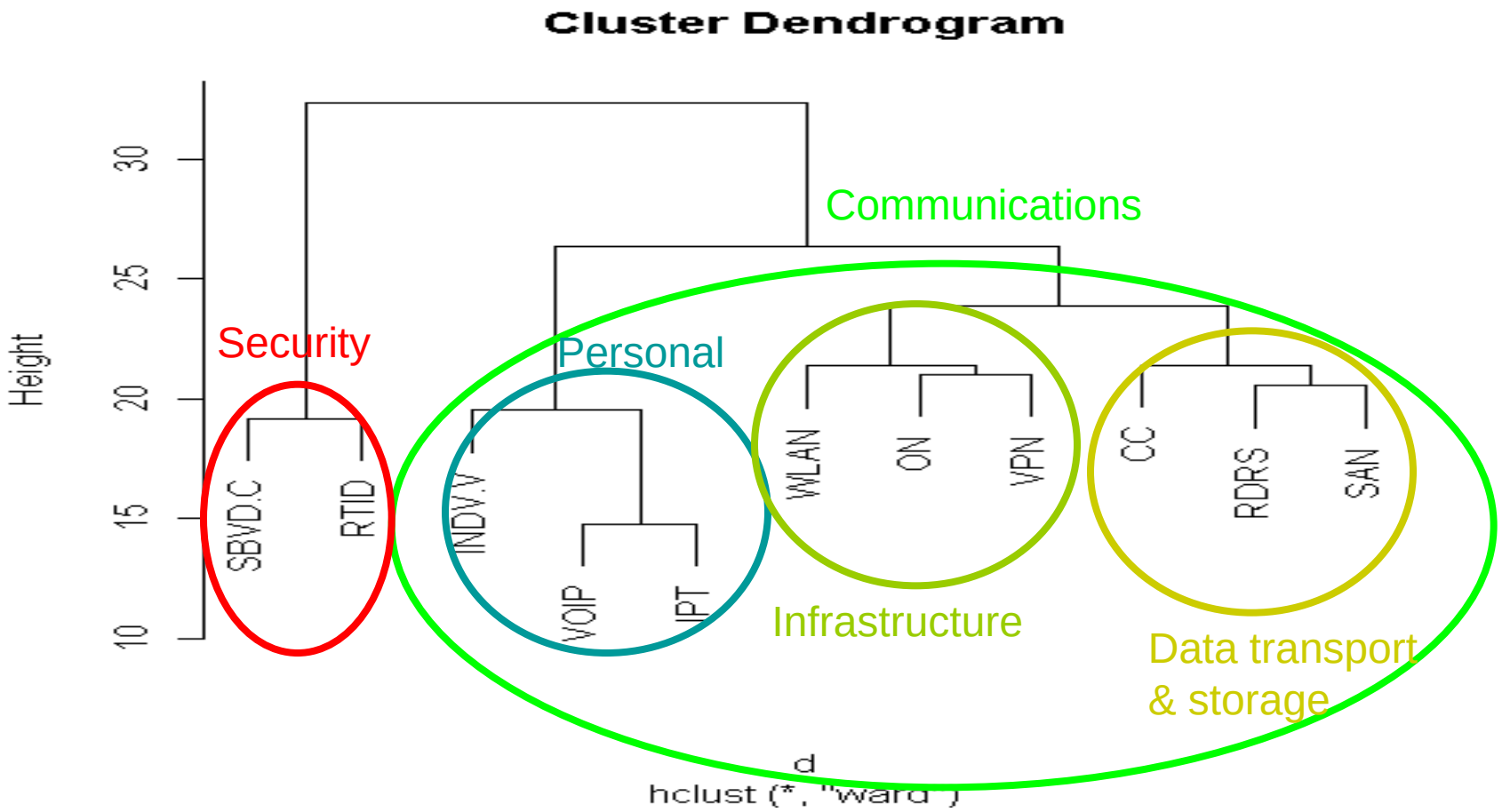
2 main techno-clusters for network applications: observations c.2007



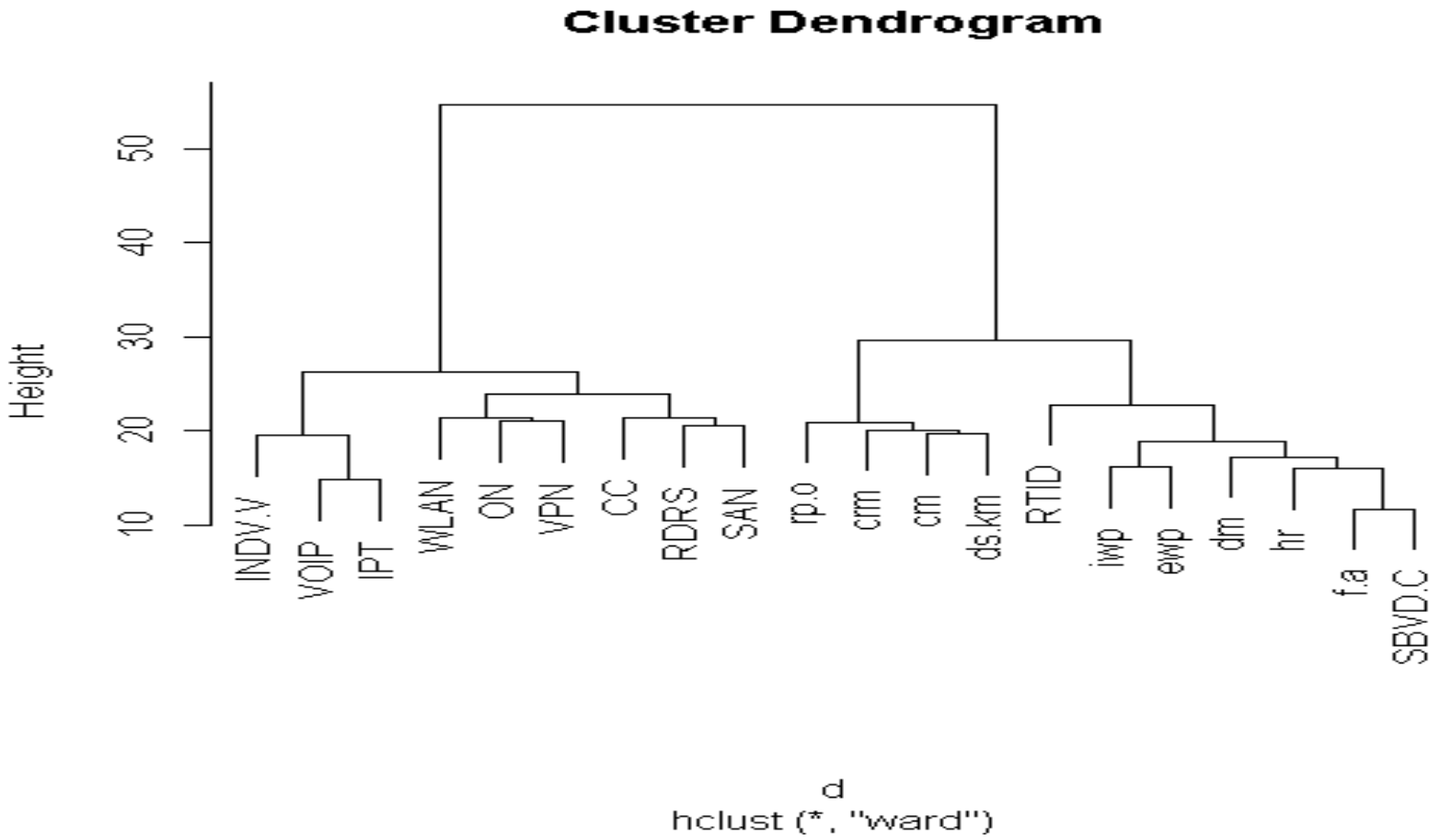
4 main techno-clusters for network services: observations c.2007



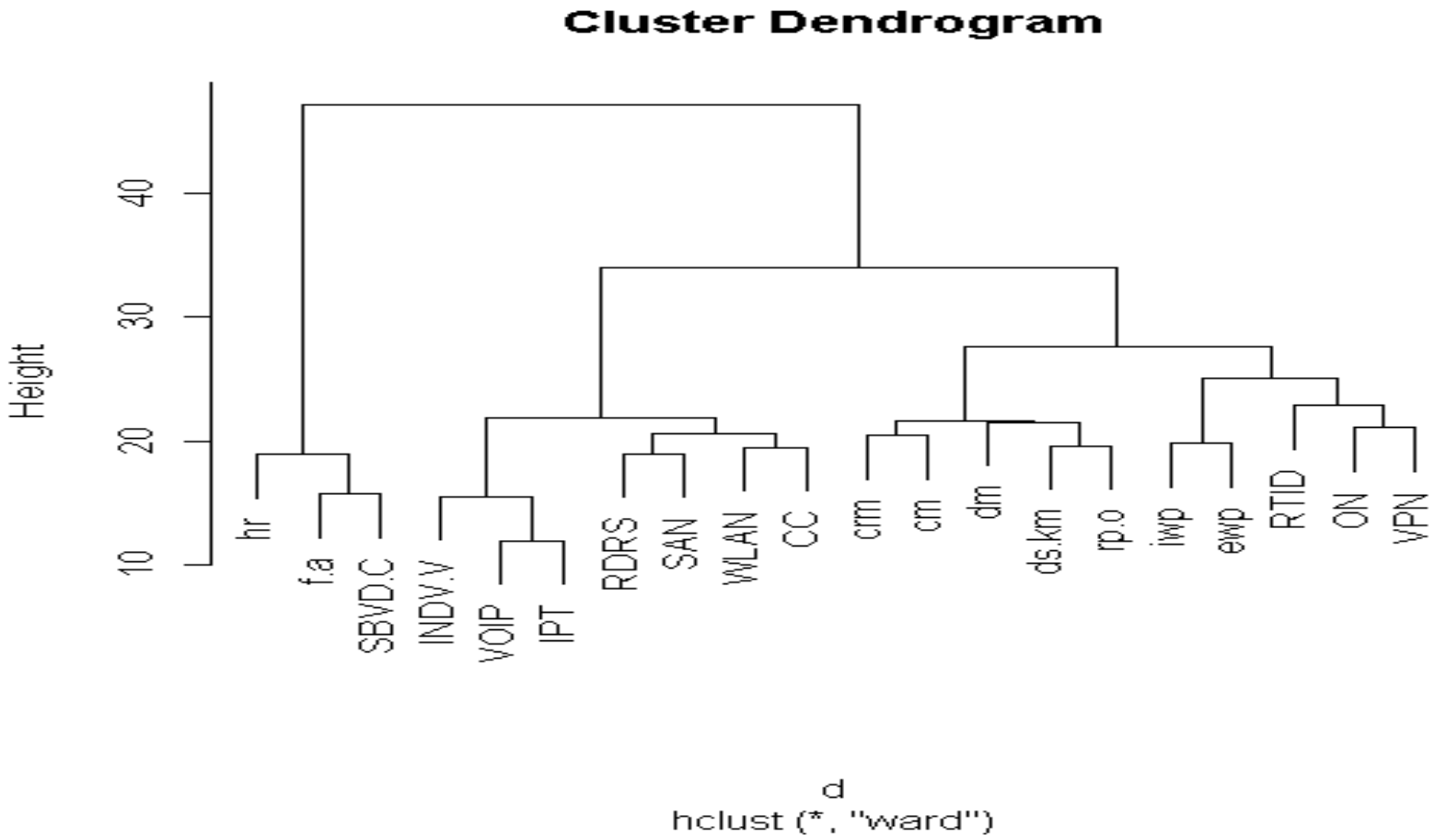
4 main techno-clusters for network services: observations c.2007



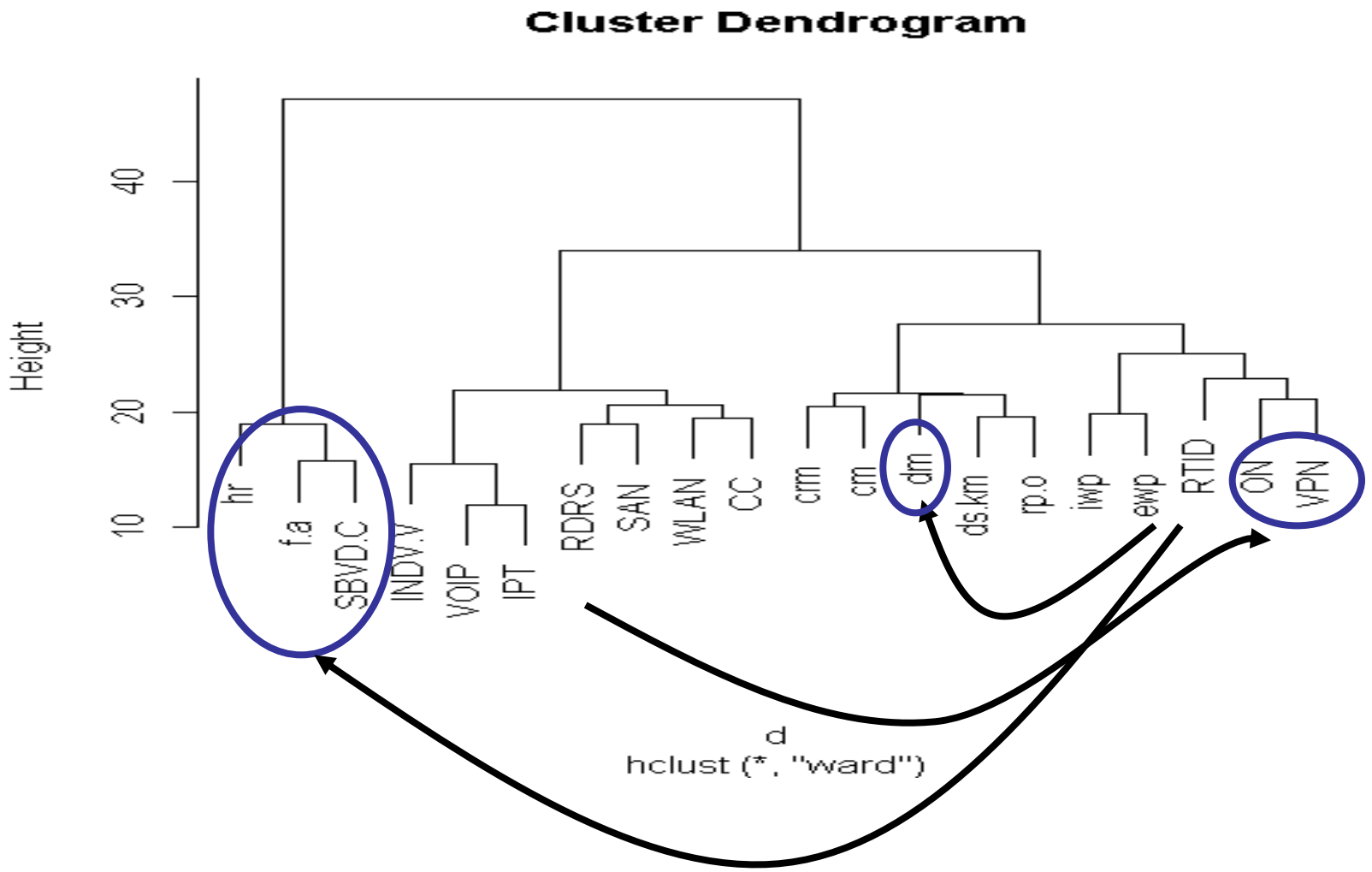
3 main techno-clusters for all technologies together, based on acquisition observations for c.2007



3 main techno-clusters for all technologies together, based on acquisition observations for 2003



3 main techno-clusters for all technologies together in 2003: differences from the pattern c.2007



The 2 techno-clusters for 2003 are robust, whether found by separating of applications and services, or by combining them

	Separately		Together	
	1	**2**	**1**	**2**
1. crm – Customer or citizen relationship management	x		x	
2. cm - Content management	x		x	
3. ds&km – Decision support and knowledge management	x		x	
4.dm - Document management		x		x
5. f&a - Finance and accounting		x		x
6. hr- Human resources		x		x
7. pr&o - Resource planning and optimization	x		x	
8. iwp- Internal web portals		x		x
9. ewp- External web portals		x		x

The services techno-clusters exhibit some instablity: due to the composition being different in c.2007 compared to 2003 when all the technologies are considered together.

	Separately				Together		
	1	**2**	**3**	**4**	**1**	**2**	**3**
1. INDV&V – Integrated network for data, voice and video	X				X		
2. SBVD&C - Server-based virus detection and containment		X				X	
3. RTID – Real-time intrusion detection		X				X	
4. RDRS – Remote disaster recovery sites				X			X
5. WLAN - Wireless LAN			X				X
6. SAN - Storage area networks				X			X
7. ON - Optical networking			X				X
8. VOIP - Voice over Internet protocol	X				X		
9. IPT - Internet protocol telephony	X				X		
10. CC - Content caching				X			X
11. VPN - Virtual private networks			X				X

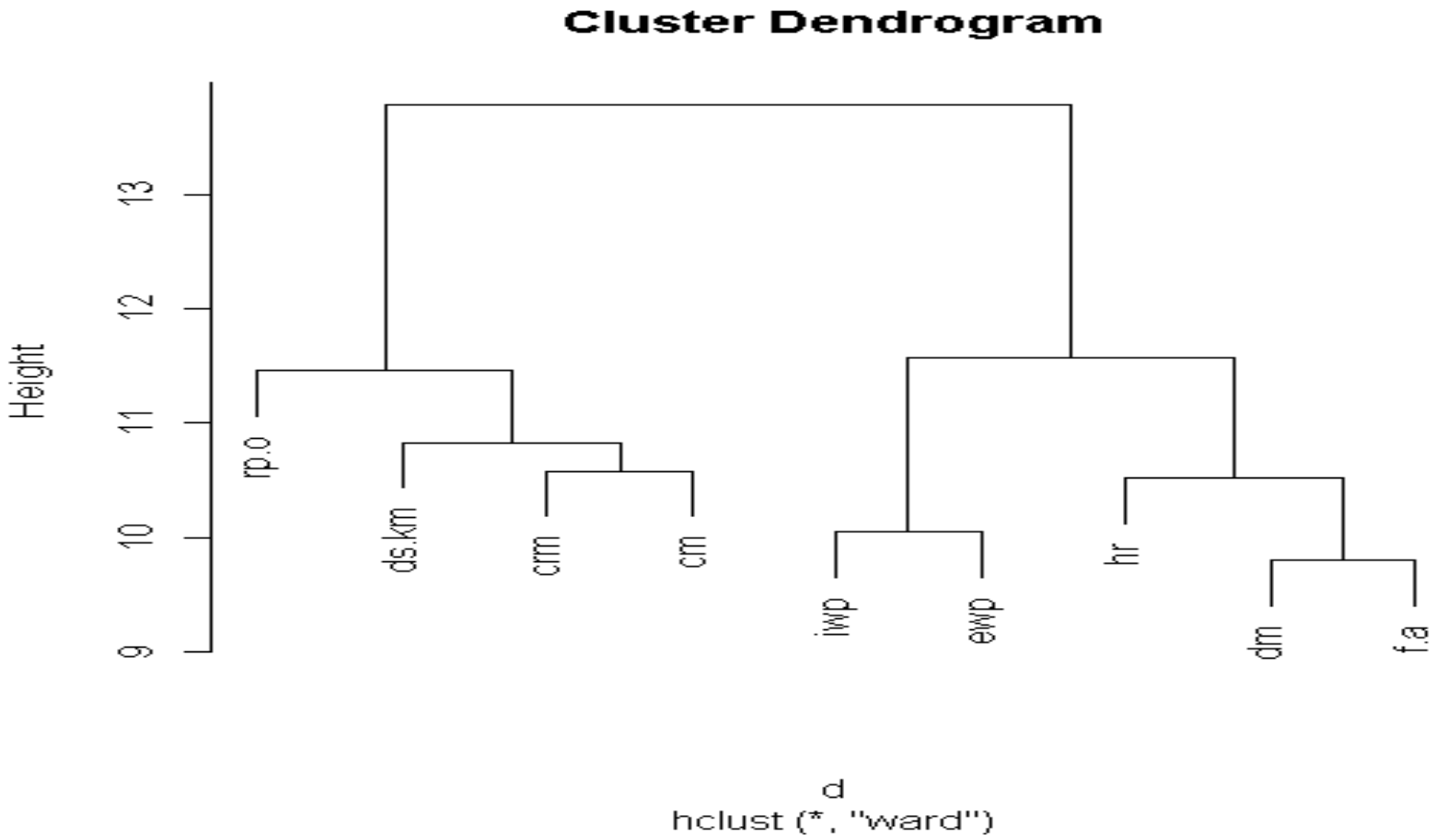
3.2.2) Examining techno-clusters' for 3 different size-classes of PSOs: mixed results with regard robustness of the acquisition patterns for applications and for services

-- applications techno-clusters are size-invariant;

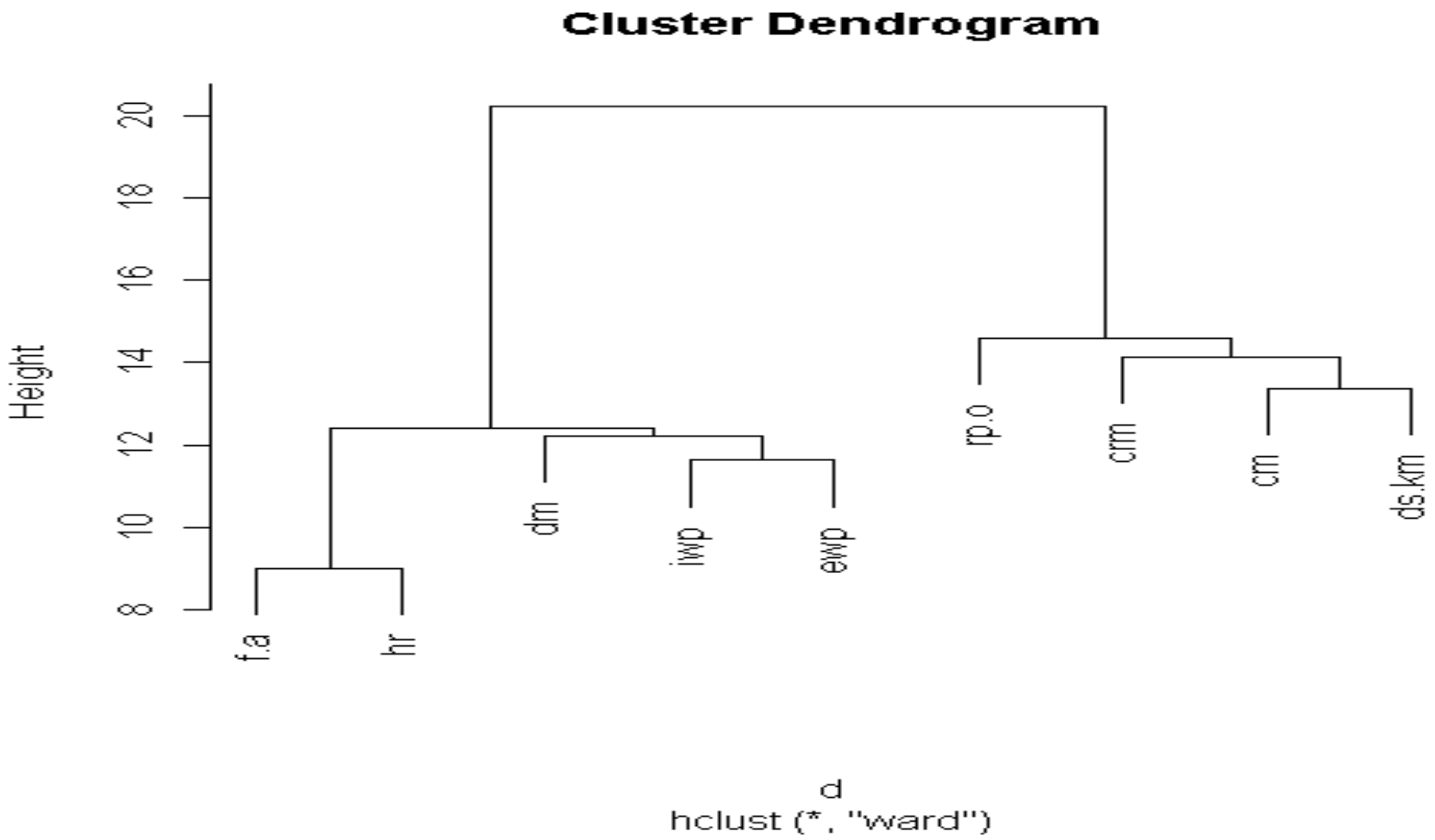
--services techno-clusters are invariant across the medium to large PSO classes, but the small PSO techno-cluster differs from the others:

this is due proximately differences in the small size-range of the acquisition configuration for three network services - Wireless Lan, Optical Networking and VPN

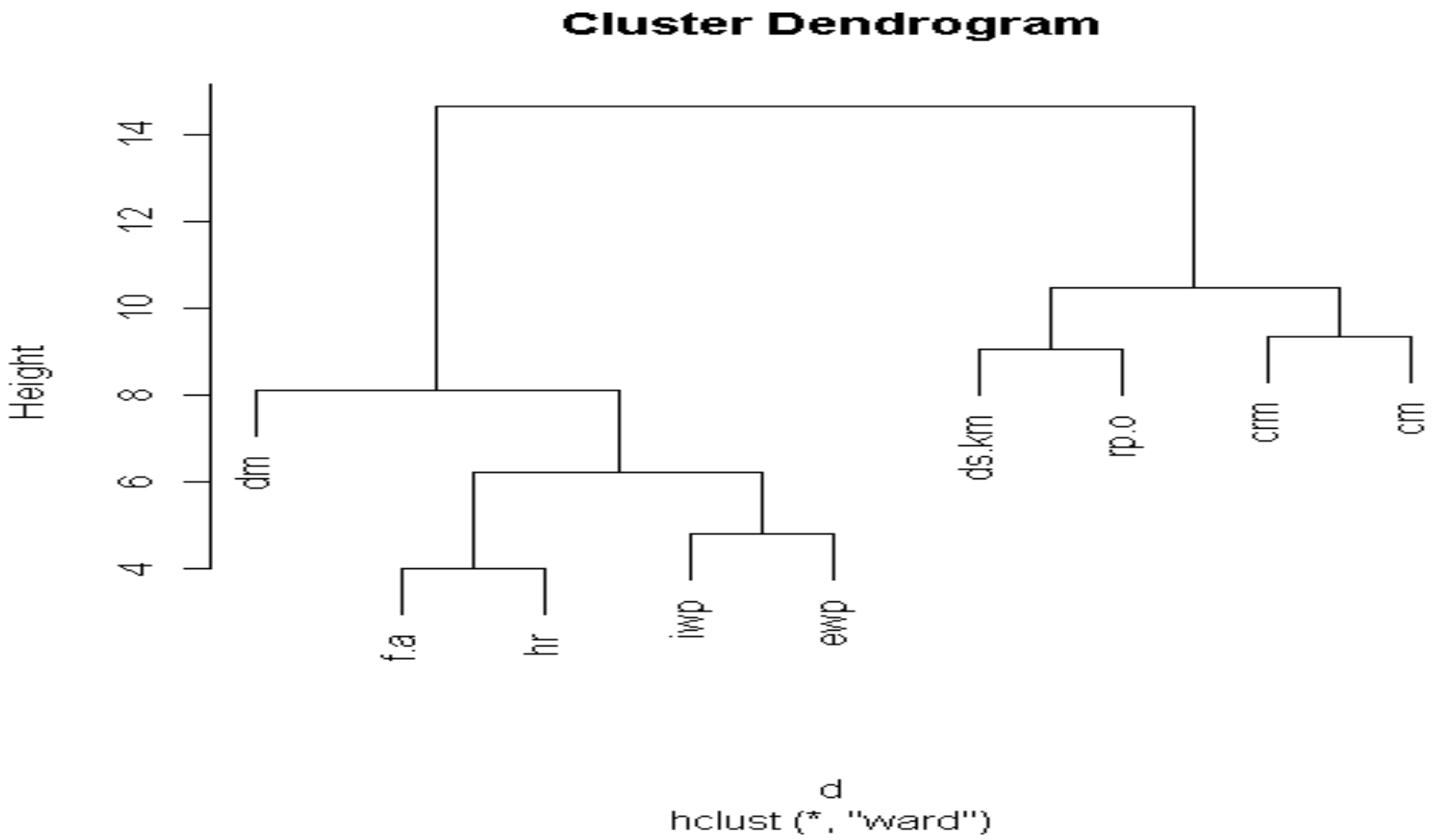
Small - applications



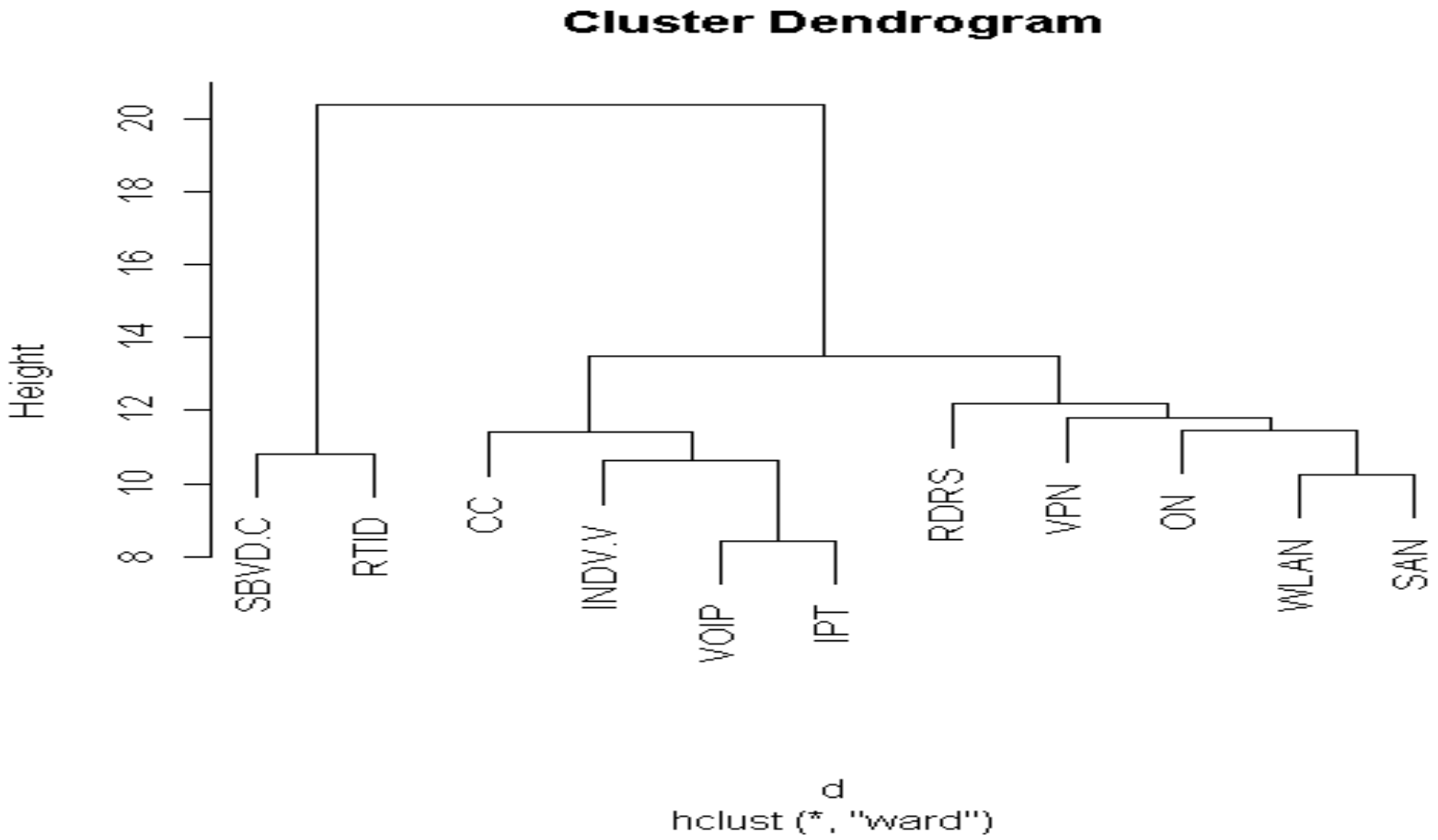
Medium - applications



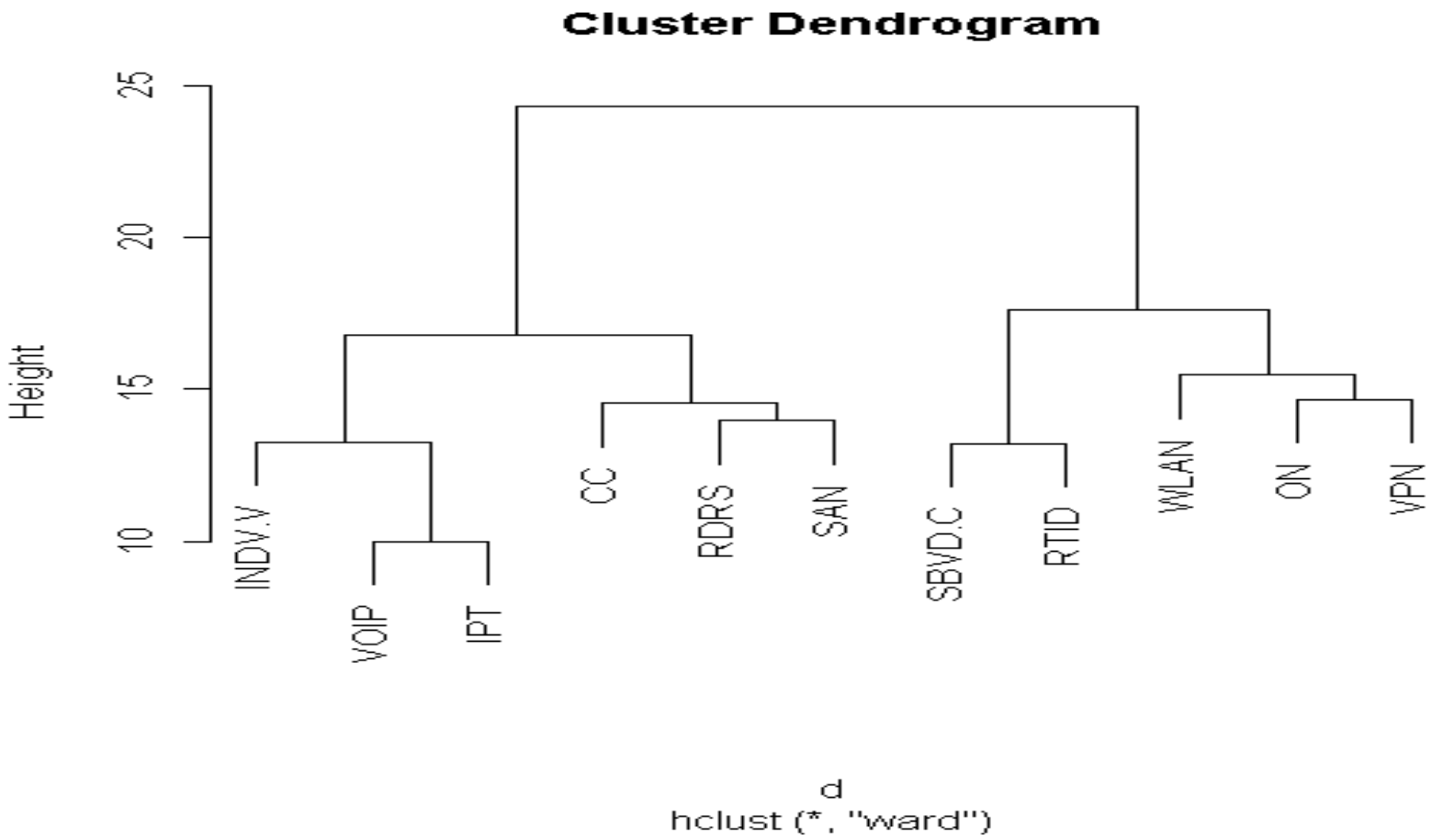
Large - applications



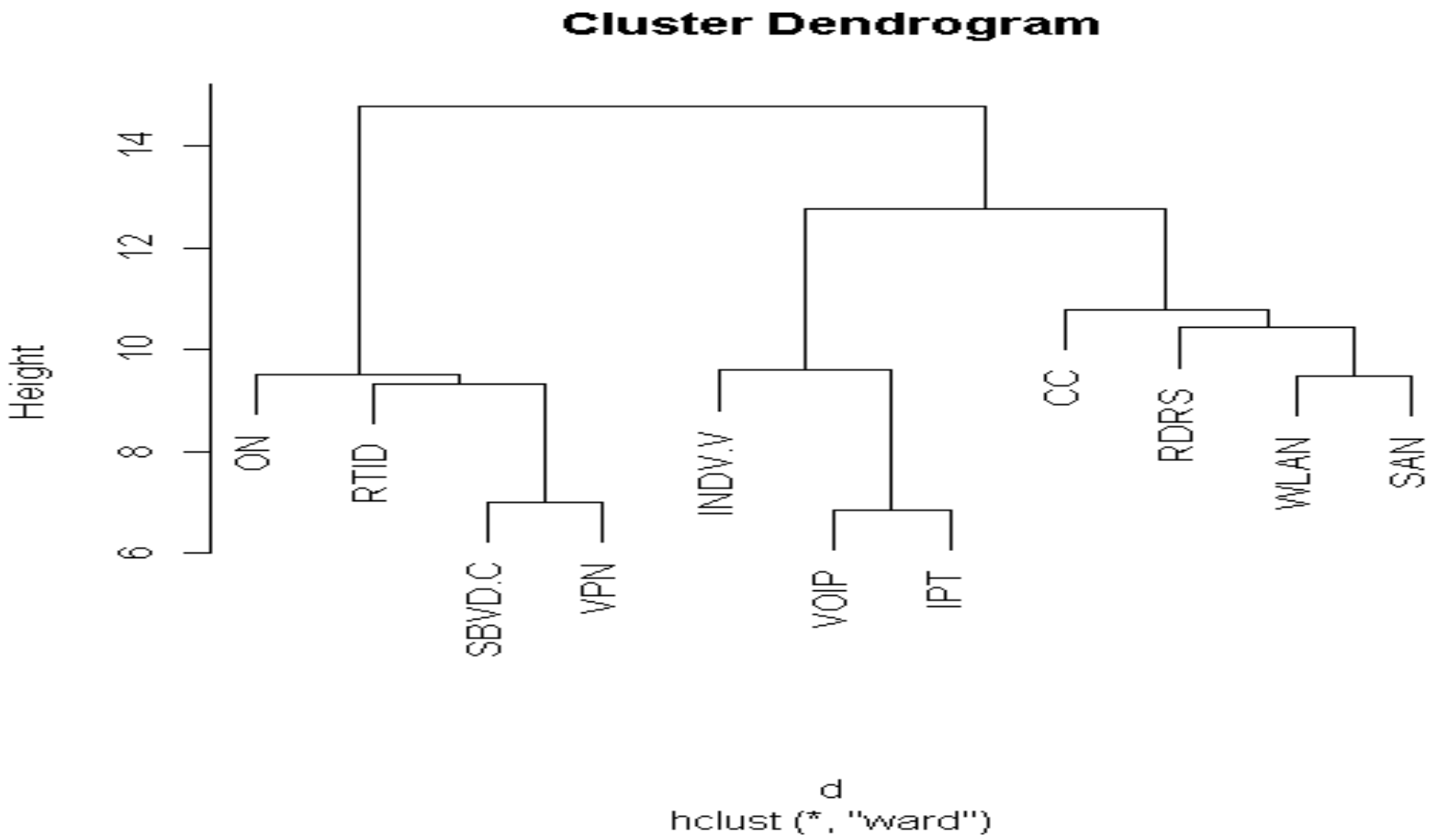
Small - services



Medium – services

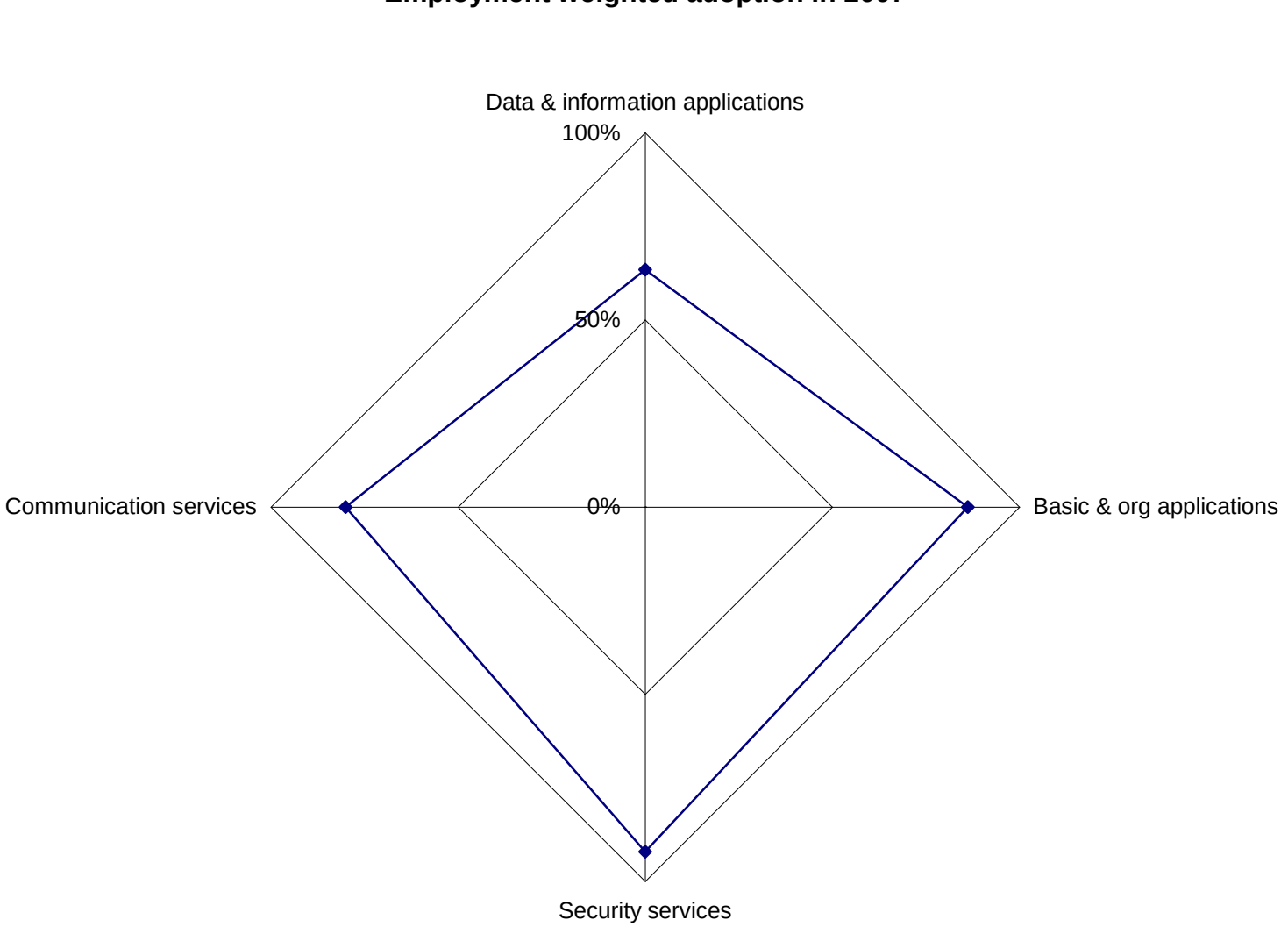


Large - services



'Techno-cluster' composition (c. 2007) for SPOs in 3 different size classes	Small		Medium		Large	
	1	2	1	2	1	2
Network services						
1. INDV&V – Integrated network for data, voice and video		x		x		x
2. SBVD&C - Server-based virus detection and containment	x		x		x	
3. RTID – Real-time intrusion detection	x		x		x	
4. RDRS – Remote disaster recovery sites		x		x		x
5. WLAN - Wireless LAN		x	x			x
6. SAN - Storage area networks		x		x		x
7. ON - Optical networking		x	x		x	
8. VOIP - Voice over Internet protocol		x		x		x
9. IPT - Internet protocol telephony		x		x		x
10. CC - Content caching		x		x		x
11. VPN - Virtual private networks		x	x		x	
Networked applications						
1. CRM – Customer or citizen relationship management	x		x		x	
2. CM - Content management	x		x		x	
3. DS&KM – Decision support and knowledge management	x		x		x	
4. DM - Document management		x		x		x
5. F&A - Finance and accounting		x		x		x
6. HR - Human resources		x		x		x
7. RP&O - Resource planning and optimization	x		x		x	
8. IWP - Internal web portals		x		x		x
9. EWP - External web portals		x		x		x

Employment-weighted extent of diffusion in W.Europe c.2007: averages for the major “techno-clusters” in services and applications



3.3) Identifying "*technical trajectories*" in PSOs' networked IT acquisitions

Methodology: **i) form technology-specific vectors of the *dated* adoption status in the population of SPOs**

ii) assign relative weights to the observations at the different dates (2003, c.2005, c.2007**), and calculate Euclidian distances between these vectors.**

iii) find the set of services-vectors, and the set of applications-vectors between which the distances are large, and use those numbers to perform hierarchical ascending clustering.

iv) clustering based on observations for the 3 dates, yields 2 major "applications techno-clusters" and 2 major "services techno-clusters"– indicating the acquisition trajectories for each type of technology.

Assignments of network services to identified «techno-clusters» and the «functional groupings»

	Dated techno-clusters						Functional groupings		
	2003		2007		2003-2007		Commun-ication	Security	Data & Doc management
	1	2	1	2	1	2			
Network services									
1. INDV&V – Integrated network for data, voice and video	x		x		x		x		
2. SBVD&C - Server-based virus detection and containment		x		x		x		x	
3. RTID – Real-time intrusion detection		x		x		x		x	
4. RDRS – Remote disaster recovery sites	x		x		x				x
5. WLAN - Wireless LAN	x		x		x		x		
6. SAN - Storage area networks	x		x		x				x
7. ON - Optical networking		x	x		x		x		
8. VOIP - Voice over Internet protocol	x		x		x		x		
9. IPT - Internet protocol telephony	x		x		x		x		
10. CC - Content caching	x		x		x				x
11. VPN - Virtual private networks		x	x		x			x	

Assignments of networked applications to identified «techno-clusters» and the «functional groupings»

	Dated techno-clusters						Functional groupings		
	2003		2007		2003-2007		Client / Customer management	Organiz-ational control	Internal management operations
	1	2	1	2	1	2			
Networked applications									
1. CRM – Customer or citizen relationship management	x		x		x		x		
2. CM - Content management	x		x		x				x
3. DS&KM – Decision support and knowledge management	x		x		x				x
4. DM - Document management	x			x	x				x
5. F&A - Finance and accounting		x		x		x		x	
6. HR - Human resources		x		x		x		x	
7. RP&O - Resource planning and optimization	x		x		x				x
8. IWP - Internal web portals		x		x		x			x
9. EWP - External web portals		x		x		x	x		

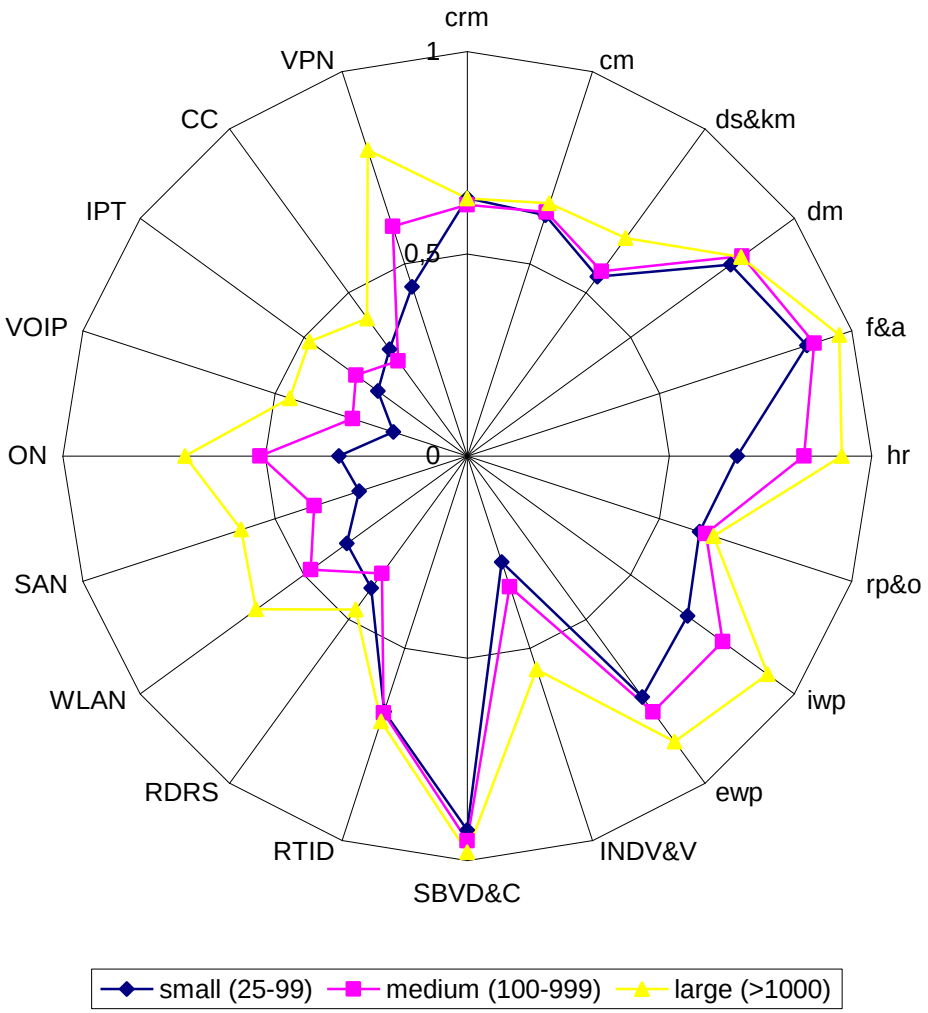
Part 3. Organizational heterogeneity and variations in the extent of diffusion

3.1 Technology-specific penetration rates for Western European PSO's grouped by employment size class:

		number of PSOs
small	25-99	334
medium	100-999	523
large	1000-2500+	245

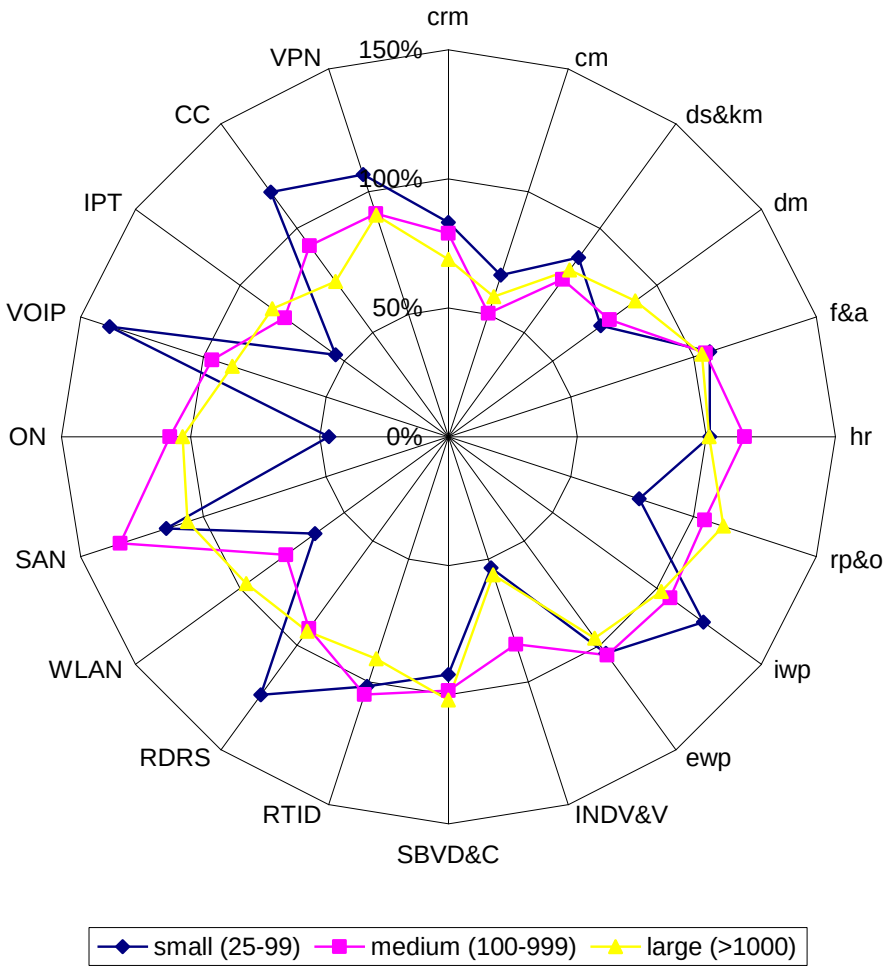
Extent of diffusion is greater for the large W. European PSOs (c.2007), especially for network services

Adoption in 2007



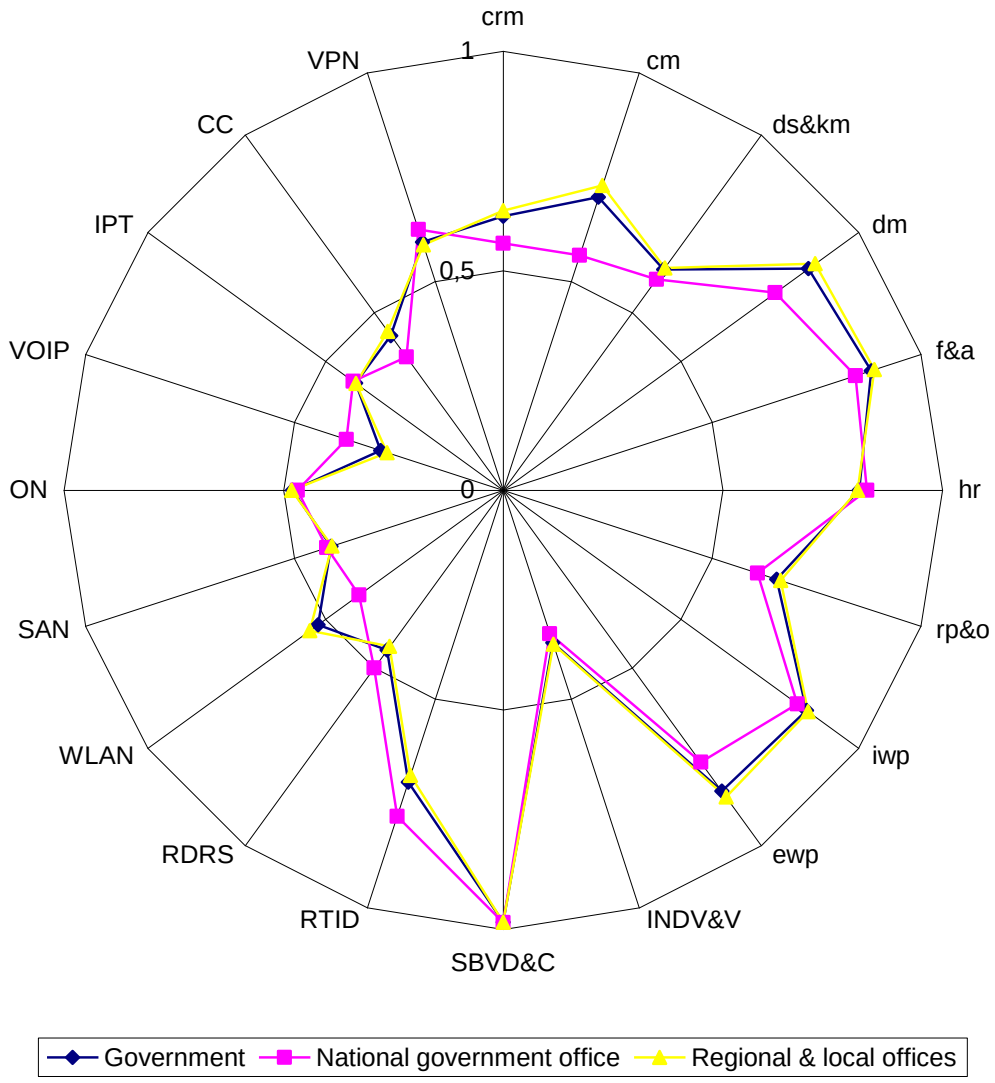
Extent of diffusion in PSO size-classes: France compared to W.Europe c. 2007

France has relatively high average penetration rates for Small- and Medium-size PSOs

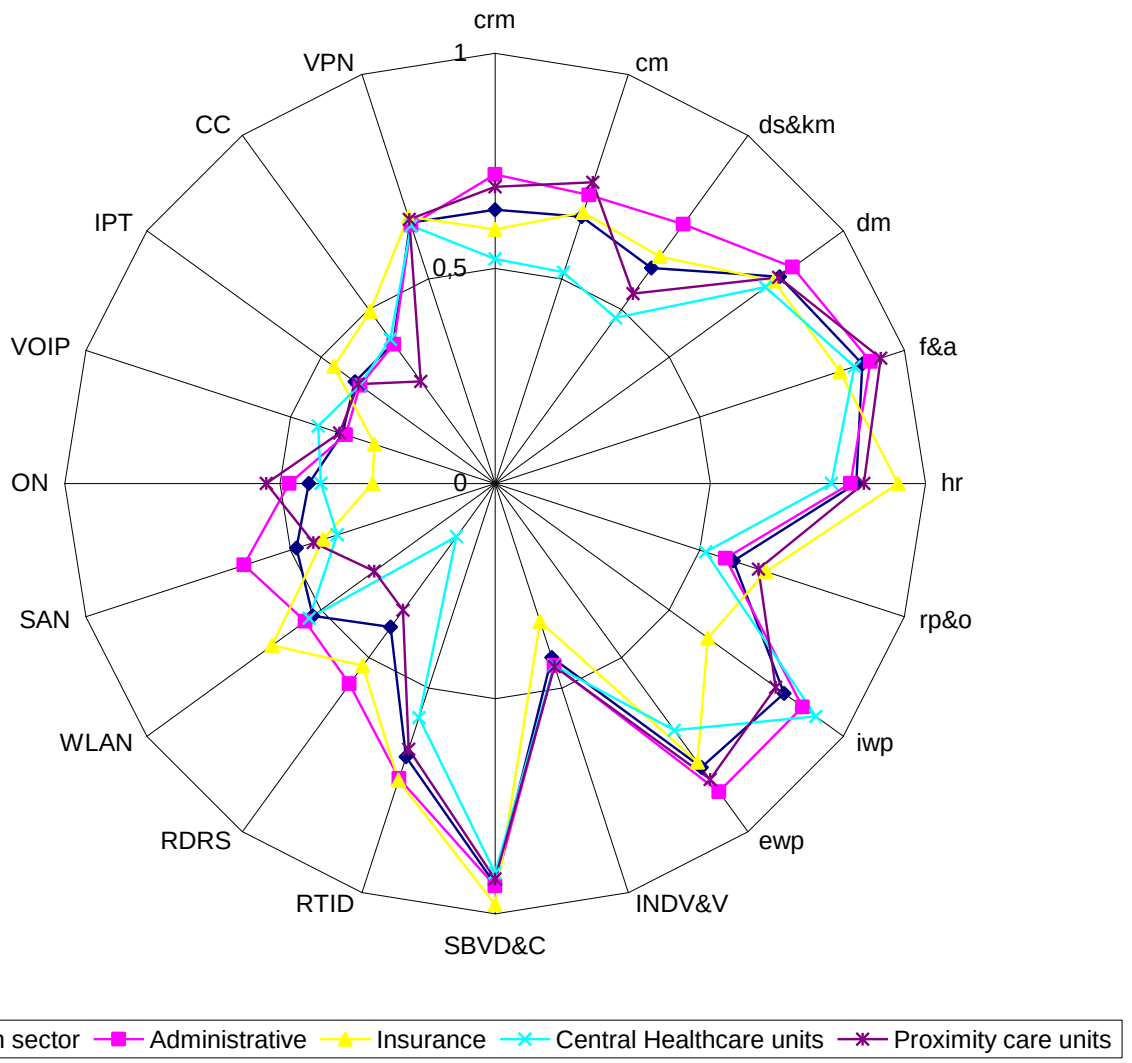


3.2 Penetration rates in Western Europe by types of SPOs: Government and Health Sectors

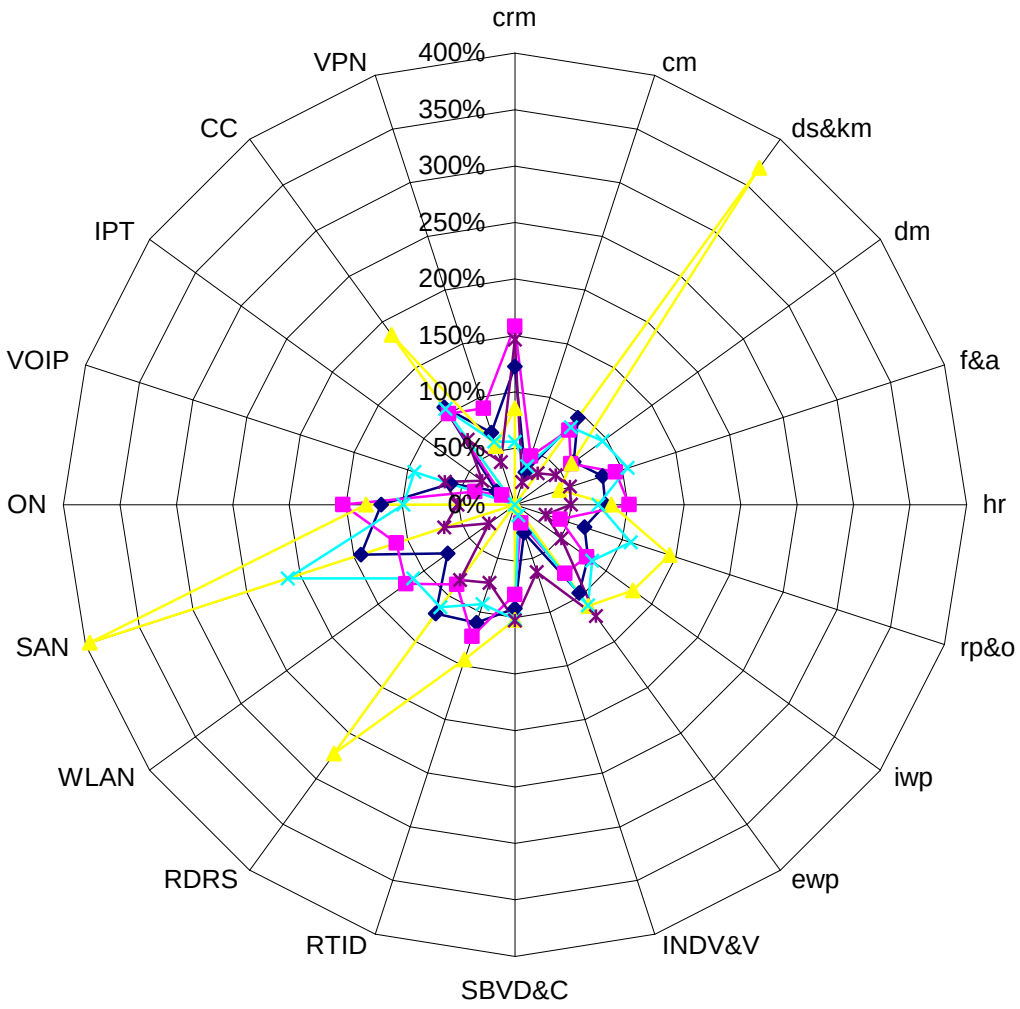
Technology-specific Penetration rates for Western Europe c.2007: Government PSOs



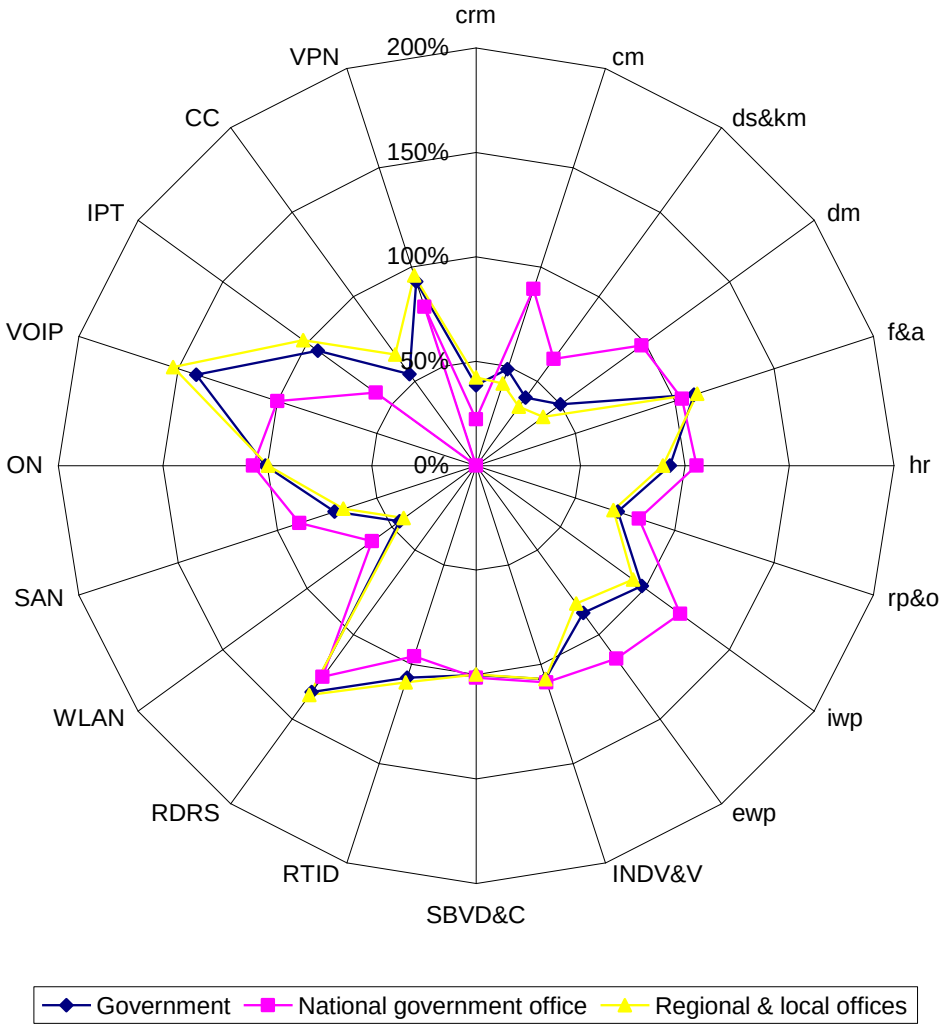
Technology-specific Penetration rates for Western Europe c.2007: Health Sector PSOs



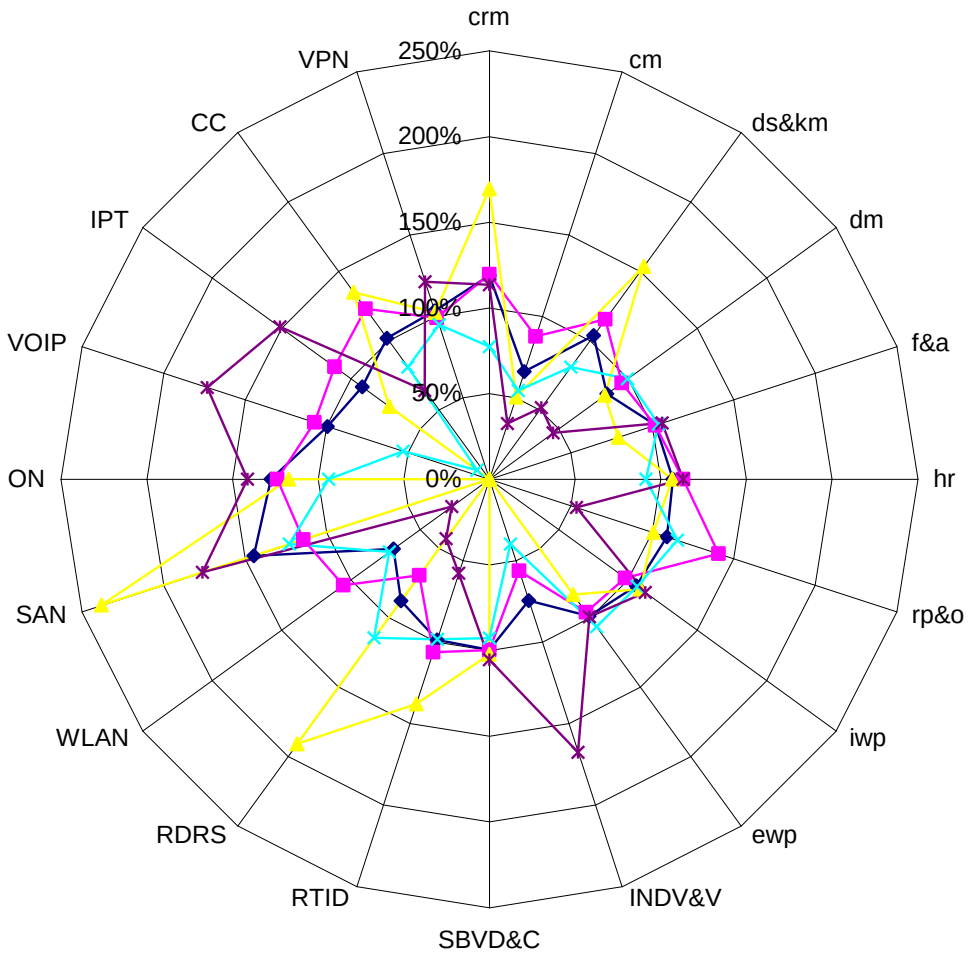
Technology-specific Penetration rates for Western Europe 2003: Health Sector PSOs



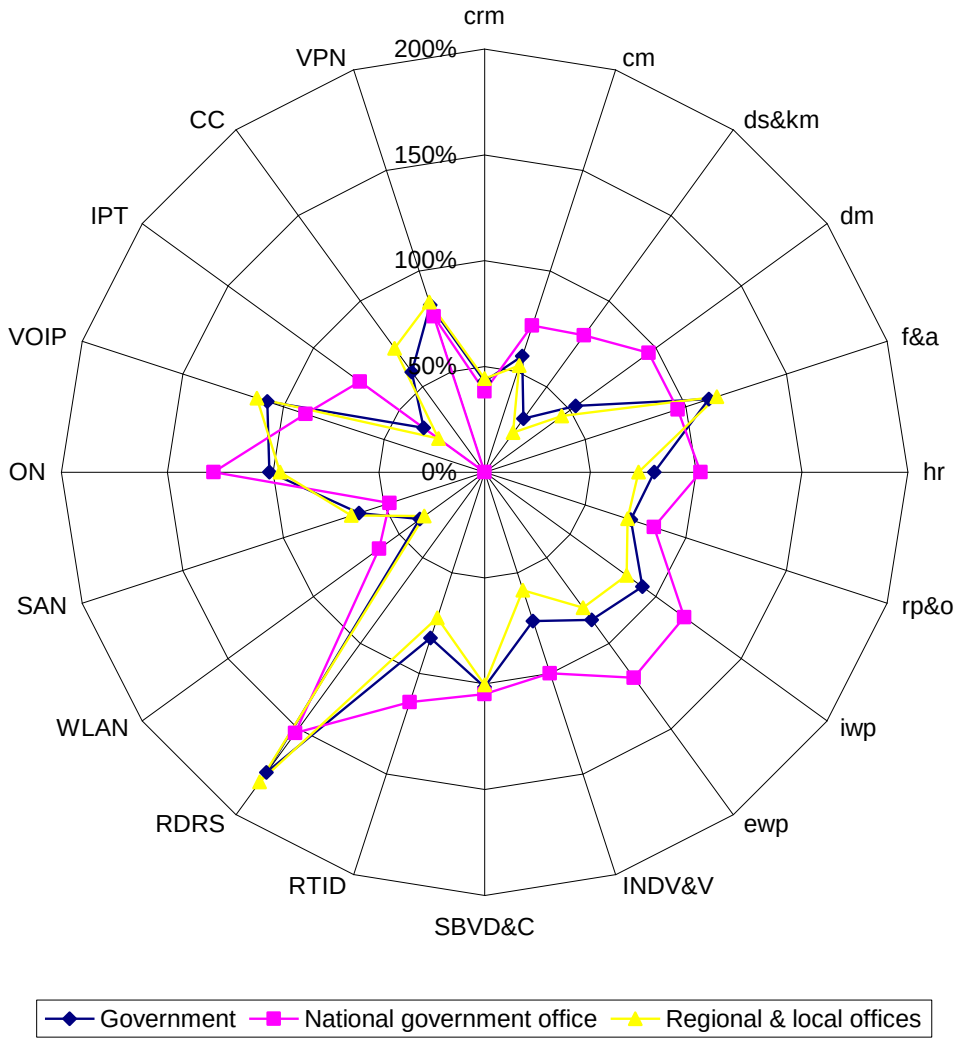
Technology-specific penetration rates for Government PSOs: **France** relative to Western Europe c.2007



Technology-specific penetration rates for Health Sector PSOs: France relative to Western Europe c.2007



Technology-specific penetration rates for Health Sector PSOs: France relative to Western Europe in 2003

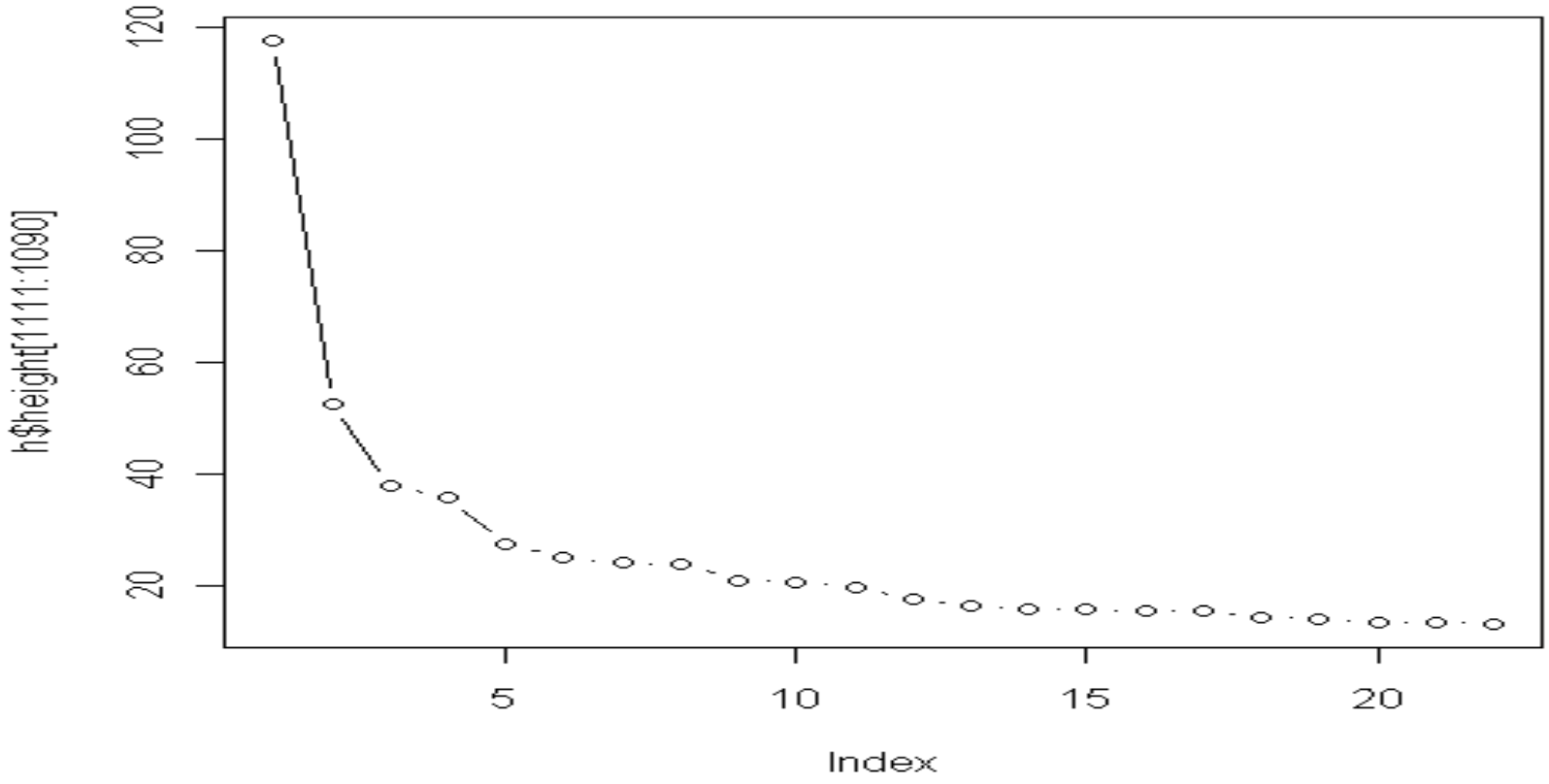


Part 4. Sub-Patterns of Diffusion: Clusters of organizations within Western Europe's public services sector

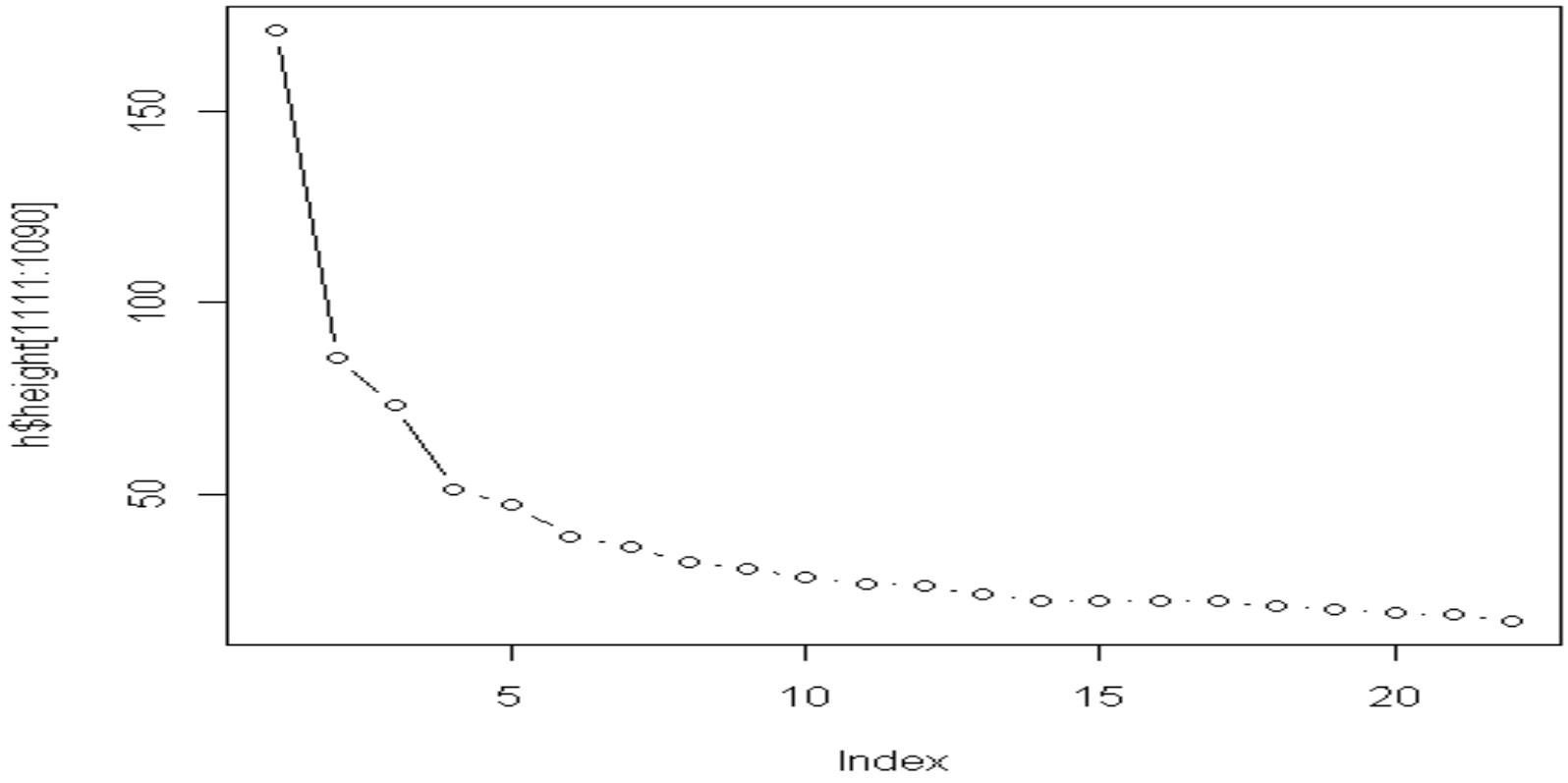
4.1. Organizational clustering: stages and trajectories

4.2 Organizational composition of the adoption clusters

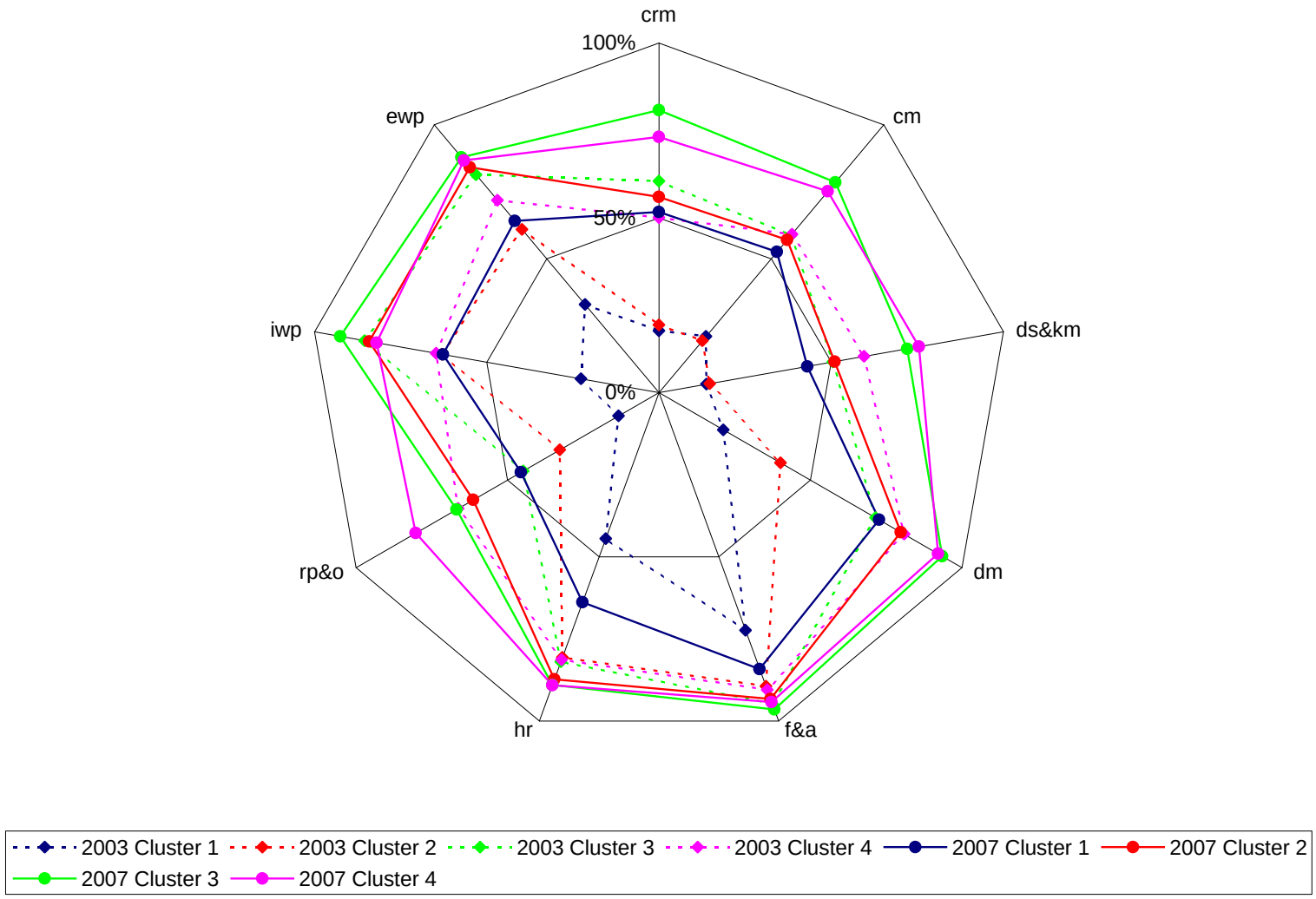
2003 hierarchical ascending clustering yields to 4 PSOs clusters



2003 – 2007 trajectories: hierarchical ascending clustering yields 5 PSO clusters

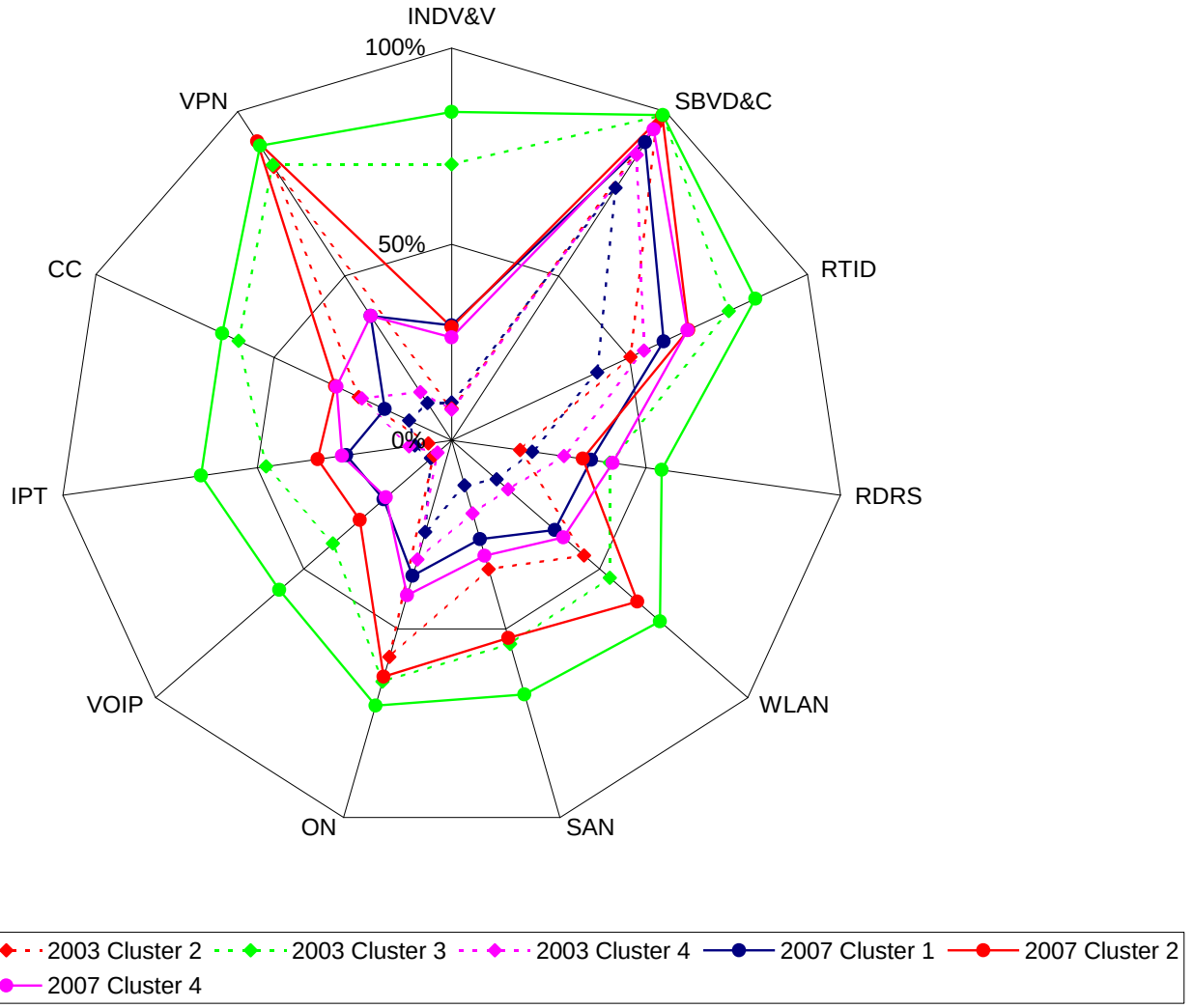


Penetration rates for applications in the 4 PSO- clusters: 2003 and c.2007



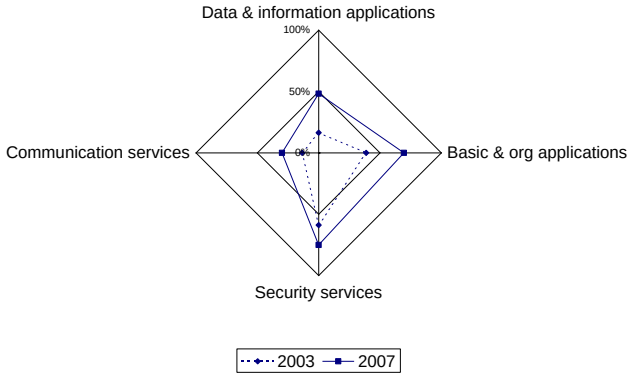
Penetration rates for services in the 4 PSO-clusters: 2003 and c.2007

The everything versus application focused path



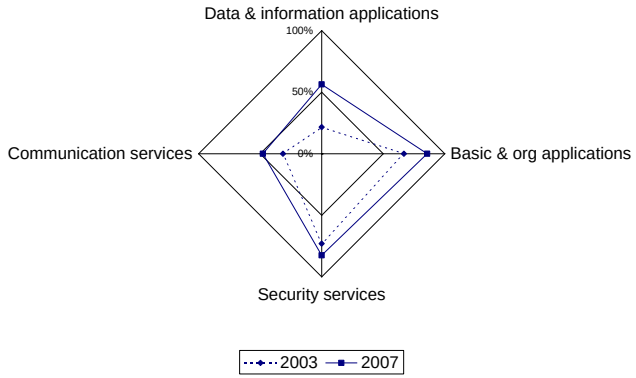
Comparison of 2003 and c2007 penetration rates for the main services and applications in each of the 4 clusters of organizations defined for 2003

Cluster 1



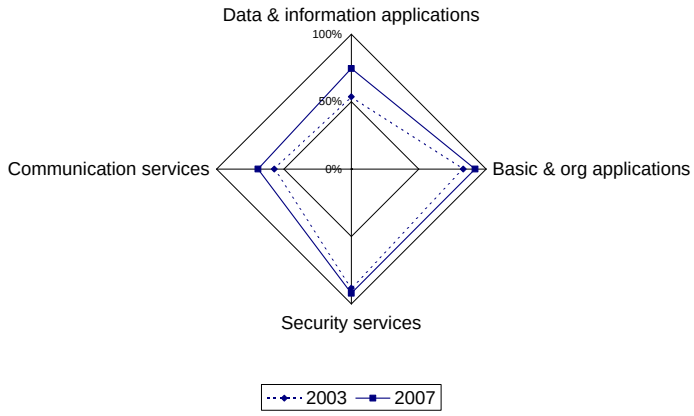
Low adopters

Cluster 2



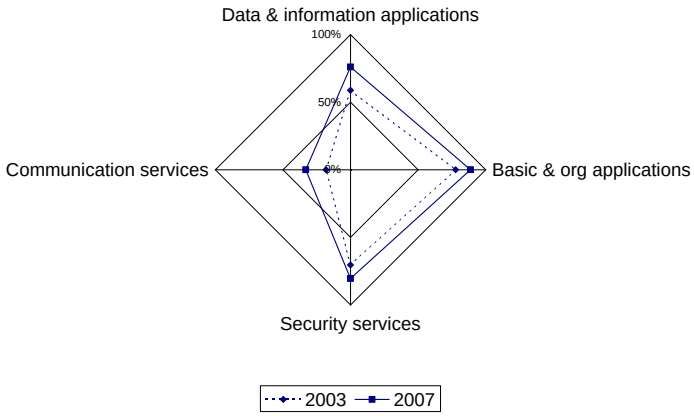
Medium adopters

Cluster 3



High adopters everything

Cluster 4



High adopters focused

Distribution of SPOs by size with each of the clusters: 2003

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Number of SPOs	362	284	172	294
Small (25-99)	39%	15%	11%	35%
Medium (100-999)	36%	27%	12%	25%
Large (>1000)	16%	36%	30%	18%

Distribution of SPOs by type with each of the clusters: 2003

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Government sector	33%	27%	16%	24%
National government office	27%	34%	22%	17%
Regional & local offices	34%	26%	16%	24%
Health sector	32%	24%	14%	30%
Administrative	24%	30%	19%	27%
Insurance	27%	18%	24%	31%
Central Healthcare units	33%	28%	12%	27%
Proximity care units	34%	18%	11%	36%

Distribution of each country's SPOs among the clusters: 2003

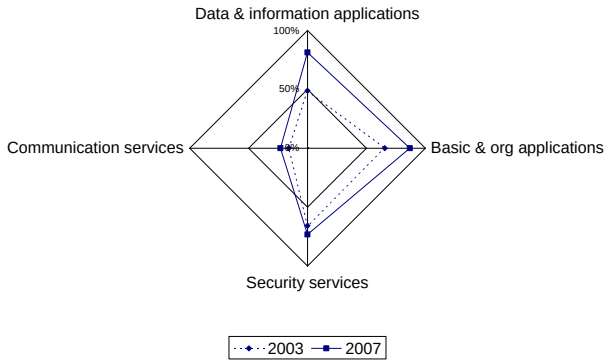
	Cluster 1	Cluster 2	Cluster 3	Cluster 4
France	40%	28%	9%	23%
Germany	48%	23%	8%	21%
Holland	30%	30%	11%	29%
Italy	27%	22%	16%	35%
Spain	50%	8%	5%	37%
Sweden	34%	20%	21%	25%
UK	18%	33%	27%	23%

Distribution of countries' SPOs among the clusters: 2003

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
France	20%	16%	8%	14%
Germany	24%	13%	7%	13%
Holland	10%	13%	8%	12%
Italy	17%	16%	19%	27%
Spain	9%	6%	11%	8%
Sweden	9%	19%	25%	14%
UK	12%	17%	22%	13%

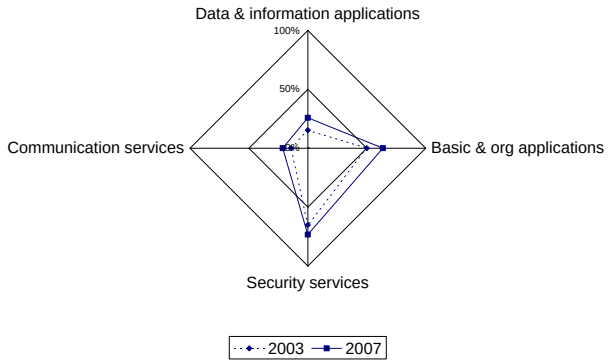
Comparison of 2003 and c2007 penetration rates for the main services and applications in each of the 4 clusters of organizations defined for 2007

Cluster 1



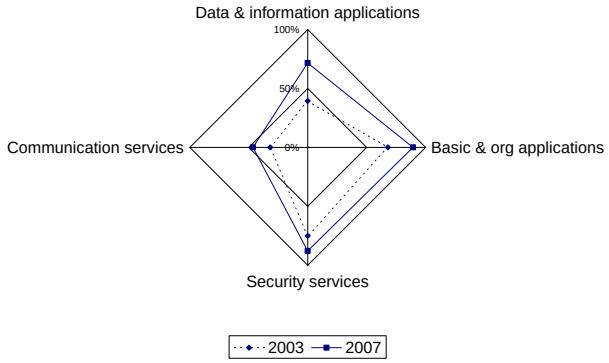
High focused ambition

Cluster 2



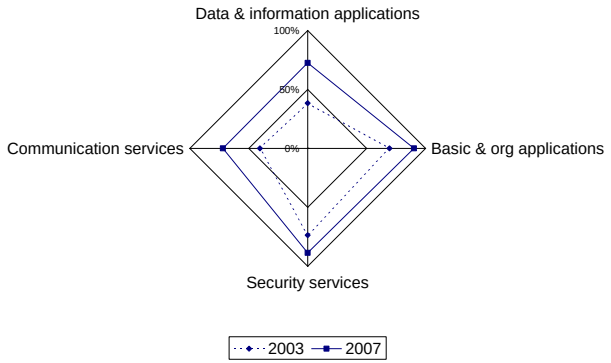
Low ambition

Cluster 3



Medium ambition

Cluster 4



High ambition for everything

Distribution of SPOs by size with each of the clusters: 2007

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
# of firms	237	296	289	290
Small (25-99)	30%	36%	21%	13%
Medium (100-999)	21%	28%	26%	25%
Large (>1000)	10%	11%	31%	47%

Distribution of SPOs by type with each of the clusters: 2007

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Government sector	21%	25%	27%	27%
National government office	19%	25%	25%	31%
Regional & local offices	21%	25%	27%	27%
Health sector	21%	29%	25%	25%
Administrative	22%	17%	30%	30%
Insurance	18%	33%	18%	31%
Central Healthcare units	19%	29%	28%	24%
Proximity care units	25%	32%	21%	22%

Distribution of SPOs by country with each of the clusters: 2007

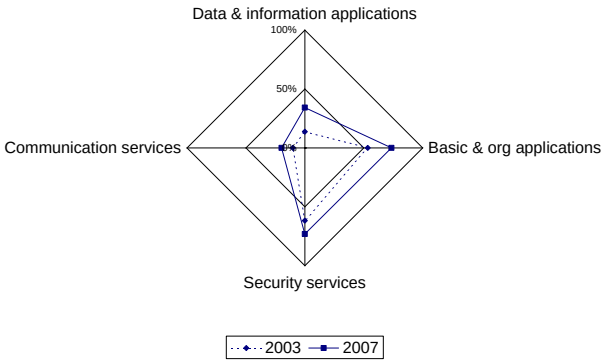
	Cluster 1	Cluster 2	Cluster 3	Cluster 4
France	11%	40%	26%	23%
Germany	33%	28%	21%	18%
Holland	22%	23%	34%	21%
Italy	25%	27%	30%	18%
Spain	45%	41%	11%	4%
Sweden	16%	16%	22%	45%
UK	15%	23%	27%	35%

Distribution of SPOs by cluster with each country: 2007

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
France	9%	24%	15%	13%
Germany	26%	17%	12%	10%
Holland	12%	10%	14%	8%
Italy	25%	20%	21%	13%
Spain	7%	5%	7%	13%
Sweden	11%	14%	15%	19%
UK	10%	9%	16%	24%

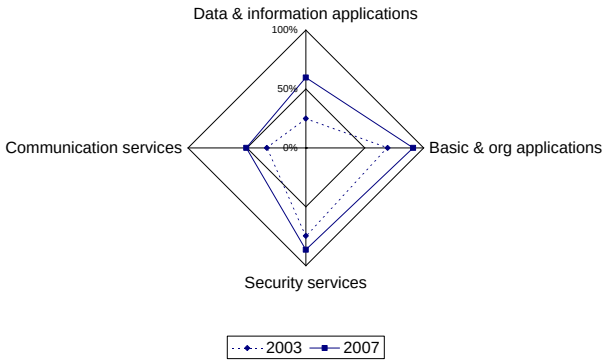
Comparison of 2003 and c2007 penetration rates in each of the 5 clusters of organizations defined for 2003-2007 trajectories

Cluster 1



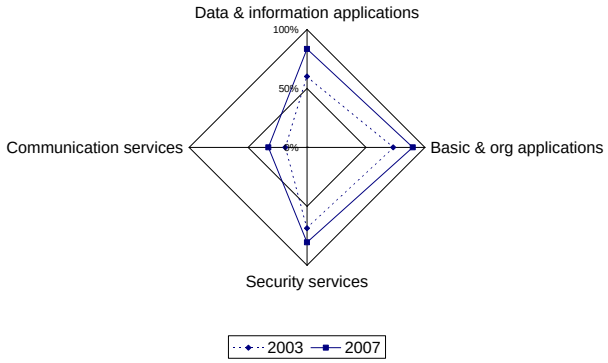
Low

Cluster 2



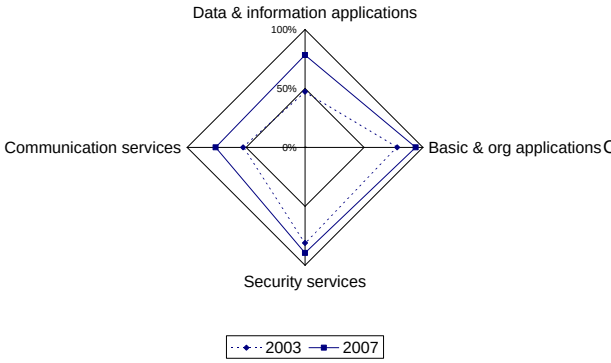
Medium

Cluster 3



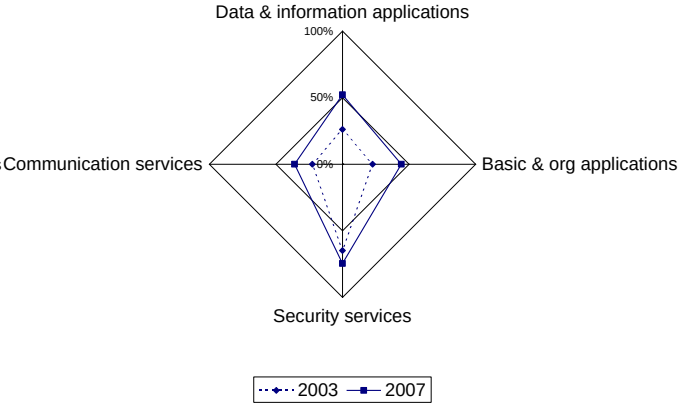
Focused

Cluster 4



Everything

Cluster 5



Low on basic & com
High on data & security

Distribution of SPOs by size with each of the clusters: 2003 - 2007

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
# of firms	268	273	275	182	114
Small (25-99)	29%	12%	35%	9%	15%
Medium (100-999)	28%	26%	23%	14%	10%
Large (>1000)	9%	40%	14%	33%	4%

Distribution of SPOs by type with each of the clusters: 2003-2007

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Government sector	25%	26%	23%	17%	8%
National government office	22%	25%	20%	20%	13%
Regional & local offices	25%	27%	23%	17%	8%
Health sector	23%	22%	27%	15%	13%
Administrative	16%	30%	30%	17%	6%
Insurance	29%	8%	24%	29%	10%
Central Healthcare units	21%	29%	25%	13%	12%
Proximity care units	26%	15%	29%	12%	18%

Distribution of SPOs by country with each of the clusters: 2003-2007

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
France	39%	33%	15%	10%	3%
Germany	16%	21%	24%	8%	31%
Holland	18%	30%	29%	10%	13%
Italy	22%	23%	29%	13%	12%
Spain	50%	5%	36%	3%	7%
Sweden	20%	19%	34%	24%	4%
UK	22%	31%	20%	24%	3%

Distribution of SPOs by cluster with each country: 2003-2007

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
France	27%	20%	10%	9%	5%
Germany	11%	12%	16%	7%	45%
Holland	9%	13%	13%	7%	14%
Italy	19%	17%	24%	14%	23%
Spain	7%	6%	12%	11%	3%
Sweden	15%	18%	13%	21%	5%
UK	11%	14%	13%	31%	6%