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A Framework for Innovation Enterprise Support Based on Intelligence Agent Approach

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Agenda

- The term *Innovation*
- How to measure Innovation ? -> GII
- The Intelligence Agent / Multi Agent System
- Author's framework of using Intelligence Agent in Innovation Enterprise
- Conclusion

INNOVATION

- M. Porter (Porter, 1990):

innovations are **technological improvements**, **better methods** and **methods of doing** a given thing. It may appear in changes in product, process, new approaches to marketing and new forms of distribution.

INNOVATION

- R. Gryffin (Griffin, 1996):

innovation can be defined as the effort of organization directed towards the development of new products and services or new applications for existing products and services.

INNOVATION

- P. Kotler (Kotler, 1999):

innovation refers to any good, service or idea that is perceived by someone as new. The idea could exist for a long time, but it is an innovation for the person who perceives it as a new one.

INNOVATION by Oslo Manual

- Innovation in the firm

- Linkages with other firms and public research institutions

- The institutional framework in which firms operate

- The role of demand
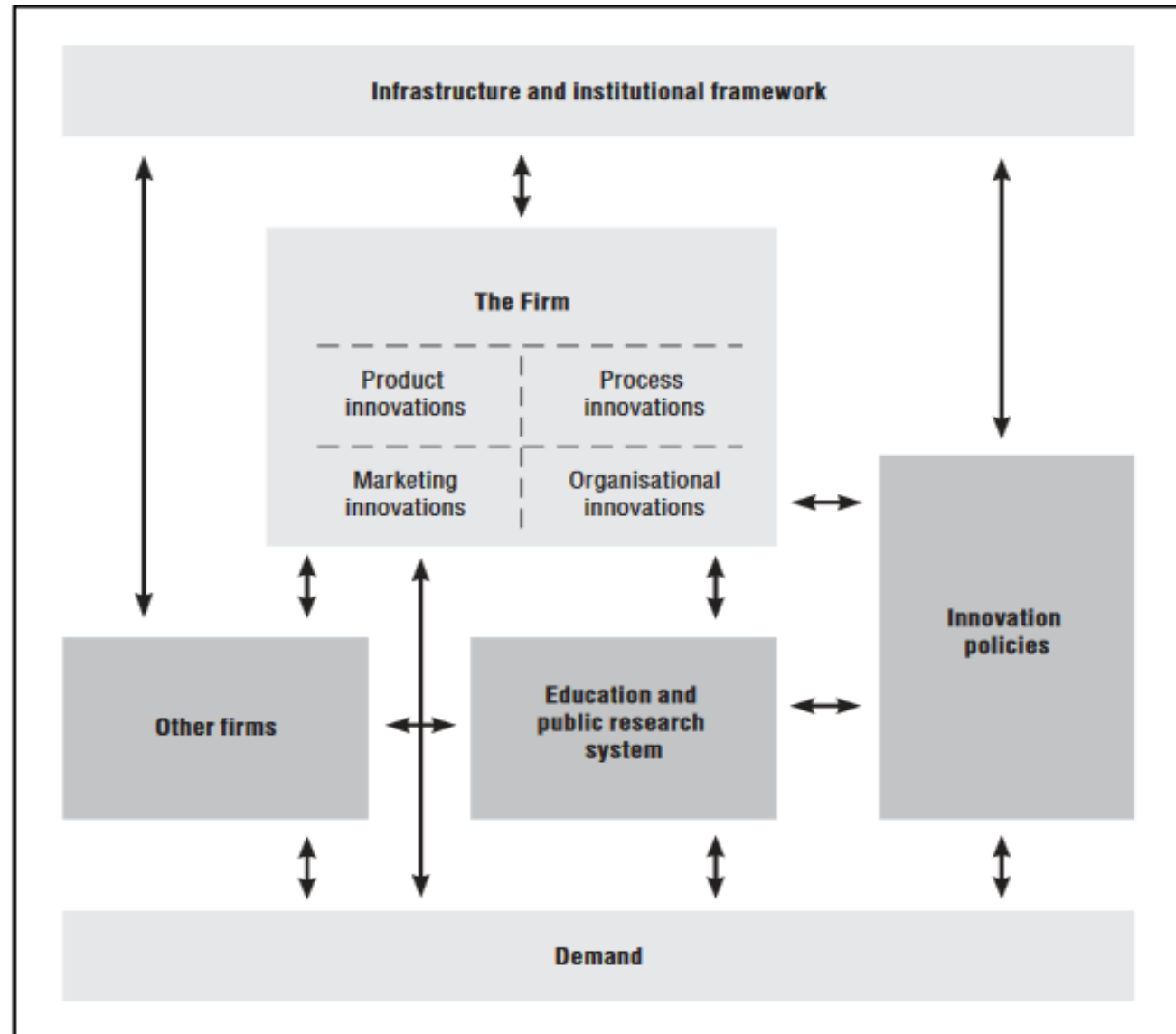
Who is leading?

The Global Innovation Index 2016

Winning with Global Innovation

The Global Innovation Index 2017

Innovation Feeding the World

TENTH EDITION

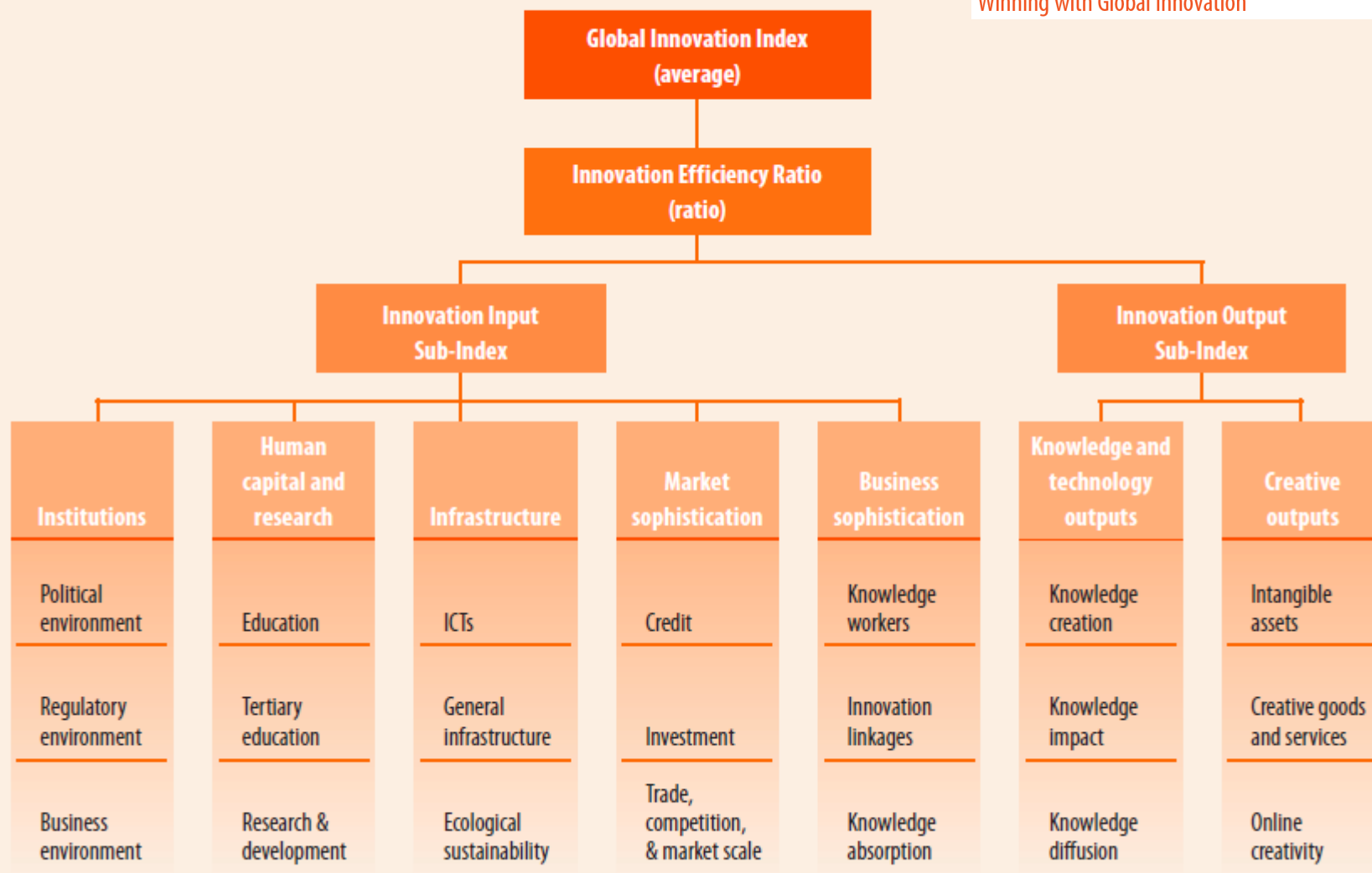| GII Sub-Index	Pillar
Innovation Input	Institutions
	Human capital and research
	Infrastructure
	Market sophistication
	Business sophistication
Innovation Output	Knowledge and technology outputs
	Creative outputs

Source: European Commission Joint Research Centre, 2017.

Figure 2: Framework of the Global Innovation Index 2016

The Global Innovation Index 2016
Winning with Global Innovation

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                          Global Innovation Index
                                 (average)

                          Innovation Efficiency Ratio
                                  (ratio)

          Innovation Input                          Innovation Output
            Sub-Index                                  Sub-Index
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Institutions	Human capital and research	Infrastructure	Market sophistication	Business sophistication	Knowledge and technology outputs	Creative outputs
Political environment	Education	ICTs	Credit	Knowledge workers	Knowledge creation	Intangible assets
Regulatory environment	Tertiary education	General infrastructure	Investment	Innovation linkages	Knowledge impact	Creative goods and services
Business environment	Research & development	Ecological sustainability	Trade, competition, & market scale	Knowledge absorption	Knowledge diffusion	Online creativity

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Who is leading?

The theme of 2016 Global Innovation Index (GII), '**Winning with Global Innovation**', particularly emphasizes the ways in which **globalized innovation strategy is a win-win prospect for all**: it inspires greater investment into industries previously not linked with innovation, and allows for cross-border investments that create benefits for the larger economy.

Source:
https://www.globalinnovationindex.org/gii-2016-report

The Global Innovation Index 2016

Winning with Global Innovation

Country/Economy	Score (0–100)	Rank	Income	Rank	Region	Rank	Efficiency Ratio	Rank	Median: 0.65
Switzerland	66.28	1	HI	1	EUR	1	0.94	5	
Sweden	63.57	2	HI	2	EUR	2	0.86	10	
United Kingdom	61.93	3	HI	3	EUR	3	0.83	14	
United States of America	61.40	4	HI	4	NAC	1	0.79	25	
Finland	59.90	5	HI	5	EUR	4	0.75	32	
Singapore	59.16	6	HI	6	SEAO	1	0.62	78	
Ireland	59.03	7	HI	7	EUR	5	0.89	8	
Denmark	58.45	8	HI	8	EUR	6	0.74	34	
Netherlands	58.29	9	HI	9	EUR	7	0.82	20	
Germany	57.94	10	HI	10	EUR	8	0.87	9	
Korea, Rep.	57.15	11	HI	11	SEAO	2	0.80	24	
Luxembourg	57.11	12	HI	12	EUR	9	1.02	1	
Iceland	55.99	13	HI	13	EUR	10	0.98	3	
Hong Kong (China)	55.69	14	HI	14	SEAO	3	0.61	83	
Canada	54.71	15	HI	15	NAC	2	0.67	57	
Japan	54.52	16	HI	16	SEAO	4	0.65	65	
New Zealand	54.23	17	HI	17	SEAO	5	0.73	40	
France	54.04	18	HI	18	EUR	11	0.73	44	
Australia	53.07	19	HI	19	SEAO	6	0.64	73	
Austria	52.65	20	HI	20	EUR	12	0.73	43	
Israel	52.28	21	HI	21	NAWA	1	0.81	23	
Norway	52.01	22	HI	22	EUR	13	0.68	55	
Belgium	51.97	23	HI	23	EUR	14	0.78	27	
Estonia	51.73	24	HI	24	EUR	15	0.91	6	
China	50.57	25	UM	1	SEAO	7	0.90	7	
Malta	50.44	26	HI	25	EUR	16	0.98	2	
Czech Republic	49.40	27	HI	26	EUR	17	0.82	21	
Spain	49.19	28	HI	27	EUR	18	0.72	48	
Italy	47.17	29	HI	28	EUR	19	0.74	33	
Portugal	46.45	30	HI	29	EUR	20	0.75	31	
Cyprus	46.34	31	HI	30	NAWA	2	0.79	26	
Slovenia	45.97	32	HI	31	EUR	21	0.74	39	
Hungary	44.71	33	HI	32	EUR	22	0.83	17	
Latvia	44.33	34	HI	33	EUR	23	0.78	28	
Malaysia	43.36	35	UM	2	SEAO	8	0.67	59	
Lithuania	41.76	36	HI	34	EUR	24	0.63	75	
Slovakia	41.70	37	HI	35	EUR	25	0.74	36	
Bulgaria	41.42	38	UM	3	EUR	26	0.83	16	
Poland	40.22	39	HI	36	EUR	27	0.65	66	
Greece	39.75	40	HI	37	EUR	28	0.61	84	

10th edition, the GII 2017 focuses on innovation in **agriculture** and **food systems.**

Source: https://www.globalinnovationindex.org /gii-2017-report

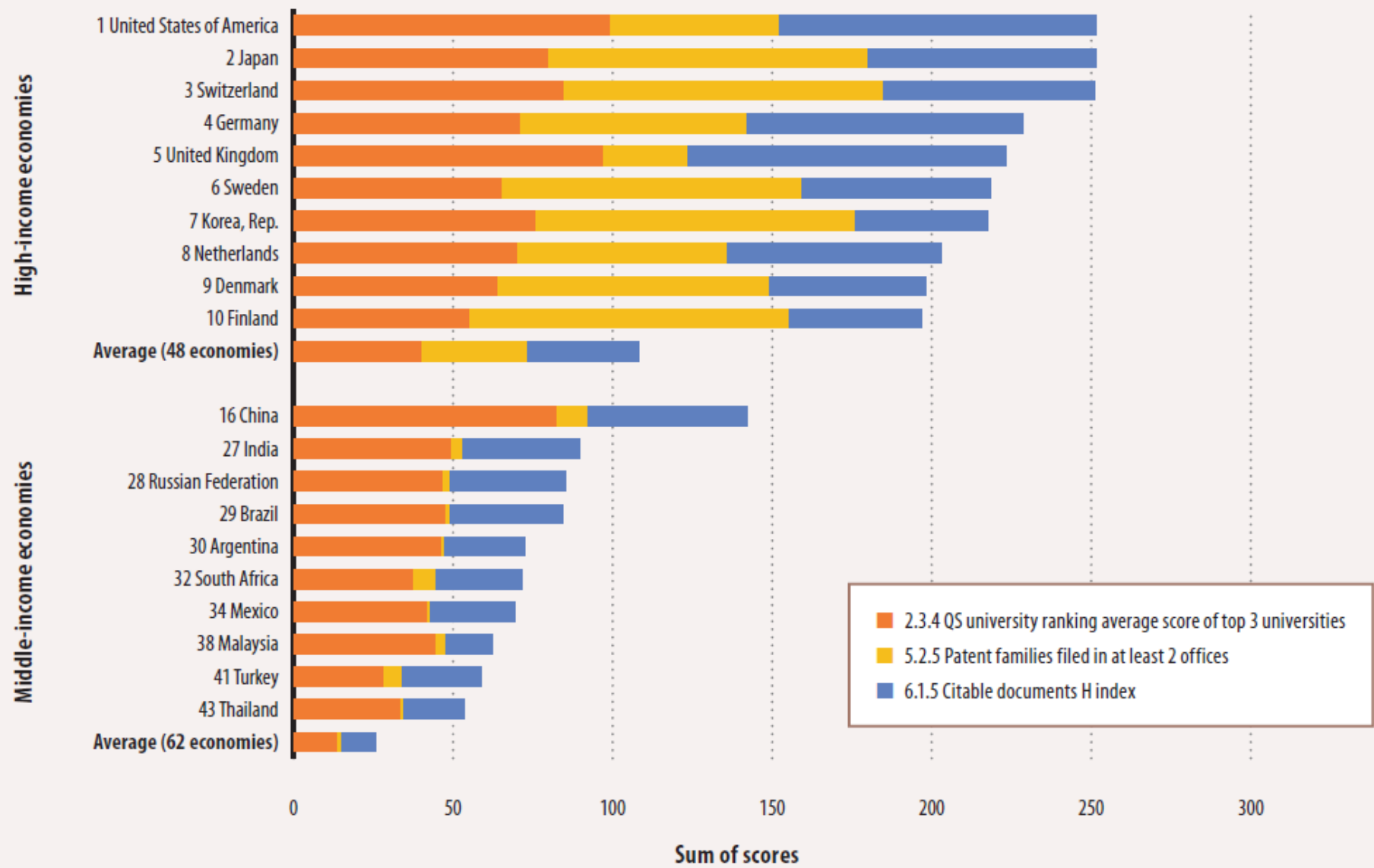| Country/Economy	Score (0–100)	Rank	Income	Rank	Region	Rank	Efficiency Ratio	Rank	Median: 0.62
Switzerland	67.69	1	HI	1	EUR	1	0.95	2	
Sweden	63.82	2	HI	2	EUR	2	0.83	12	
Netherlands	63.36	3	HI	3	EUR	3	0.93	4	
United States of America	61.40	4	HI	4	NAC	1	0.78	21	
United Kingdom	60.89	5	HI	5	EUR	4	0.78	20	
Denmark	58.70	6	HI	6	EUR	5	0.71	34	
Singapore	58.69	7	HI	7	SEAO	1	0.62	63	
Finland	58.49	8	HI	8	EUR	6	0.70	37	
Germany	58.39	9	HI	9	EUR	7	0.84	7	
Ireland	58.13	10	HI	10	EUR	8	0.85	6	
Korea, Rep.	57.70	11	HI	11	SEAO	2	0.82	14	
Luxembourg	56.40	12	HI	12	EUR	9	0.97	1	
Iceland	55.76	13	HI	13	EUR	10	0.86	5	
Japan	54.72	14	HI	14	SEAO	3	0.67	49	
France	54.18	15	HI	15	EUR	11	0.71	35	
Hong Kong (China)	53.88	16	HI	16	SEAO	4	0.61	73	
Israel	53.88	17	HI	17	NAWA	1	0.77	23	
Canada	53.65	18	HI	18	NAC	2	0.64	59	
Norway	53.14	19	HI	19	EUR	12	0.66	51	
Austria	53.10	20	HI	20	EUR	13	0.69	41	
New Zealand	52.87	21	HI	21	SEAO	5	0.65	56	
China	52.54	22	UM	1	SEAO	6	0.94	3	
Australia	51.83	23	HI	22	SEAO	7	0.60	76	
Czech Republic	50.98	24	HI	23	EUR	14	0.83	13	
Estonia	50.93	25	HI	24	EUR	15	0.79	19	
Malta	50.60	26	HI	25	EUR	16	0.84	8	
Belgium	49.85	27	HI	26	EUR	17	0.67	47	
Spain	48.81	28	HI	27	EUR	18	0.70	36	
Italy	46.96	29	HI	28	EUR	19	0.73	31	
Cyprus	46.84	30	HI	29	NAWA	2	0.74	28	
Portugal	46.05	31	HI	30	EUR	20	0.71	33	
Slovenia	45.80	32	HI	31	EUR	21	0.68	44	
Latvia	44.61	33	HI	32	EUR	22	0.74	26	
Slovakia	43.43	34	HI	33	EUR	23	0.75	25	
United Arab Emirates	43.24	35	HI	34	NAWA	3	0.49	104	
Bulgaria	42.84	36	UM	2	EUR	24	0.80	15	
Malaysia	42.72	37	UM	3	SEAO	8	0.68	46	
Poland	41.99	38	HI	35	EUR	25	0.67	48	
Hungary	41.74	39	HI	36	EUR	26	0.73	30	
Lithuania	41.17	40	HI	37	EUR	27	0.59	84	
Croatia	39.80	41	HI	38	EUR	28	0.66	52	

Table 4: GII 2017 and Input/Output Sub-Indices: Ranks and 90% confidence intervals

Country/Economy	GII 2017		Input Sub-Index		Output Sub-Index	
	Rank	Interval	Rank	Interval	Rank	Interval
Switzerland	1	[1, 1]	3	[2, 4]	1	[1, 1]
Sweden	2	[2, 3]	2	[1, 4]	3	[3, 4]
Netherlands	3	[2, 3]	9	[8, 13]	2	[2, 2]
United States of America	4	[4, 5]	5	[2, 8]	5	[4, 8]
United Kingdom	5	[4, 5]	7	[4, 7]	6	[5, 10]
Denmark	6	[6, 10]	6	[4, 8]	12	[10, 13]
Singapore	7	[6, 11]	1	[1, 2]	17	[16, 19]
Finland	8	[6, 9]	4	[4, 8]	13	[11, 13]
Germany	9	[6, 9]	17	[14, 18]	7	[4, 7]
Ireland	10	[7, 12]	19	[13, 19]	8	[5, 12]
Korea, Republic of	11	[7, 11]	16	[11, 19]	9	[5, 10]
Luxembourg	12	[11, 13]	24	[23, 27]	4	[3, 6]
Iceland	13	[13, 18]	21	[20, 22]	10	[9, 14]
Japan	14	[13, 15]	11	[9, 11]	20	[17, 21]
France	15	[13, 17]	15	[13, 18]	18	[16, 19]
Hong Kong (China)	16	[13, 21]	8	[4, 10]	25	[23, 25]
Israel	17	[14, 21]	20	[12, 21]	14	[14, 20]
Canada	18	[17, 22]	10	[8, 13]	23	[23, 29]
Norway	19	[18, 21]	14	[12, 19]	22	[22, 23]
Austria	20	[17, 21]	18	[15, 20]	21	[20, 21]
New Zealand	21	[19, 23]	13	[12, 20]	24	[22, 24]
China	22	[16, 23]	31	[24, 33]	11	[8, 11]
Australia	23	[22, 26]	12	[10, 16]	30	[29, 30]
Czech Republic	24	[21, 26]	27	[25, 28]	16	[13, 16]
Estonia	25	[24, 26]	26	[24, 27]	19	[16, 20]
Malta	26	[24, 26]	28	[27, 31]	15	[14, 17]
Belgium	27	[27, 27]	22	[21, 22]	27	[26, 29]
Spain	28	[28, 28]	25	[23, 27]	26	[25, 27]
Italy	29	[29, 30]	29	[27, 32]	29	[26, 29]
Cyprus	30	[29, 31]	32	[29, 33]	28	[26, 31]
Portugal	31	[30, 32]	33	[30, 33]	31	[31, 33]
Slovenia	32	[31, 32]	30	[27, 32]	34	[34, 35]
Latvia	33	[33, 34]	35	[35, 38]	33	[29, 35]
Slovakia	34	[33, 35]	39	[38, 41]	35	[32, 35]
United Arab Emirates	35	[34, 40]	23	[23, 31]	56	[54, 58]
Bulgaria	36	[34, 37]	45	[41, 47]	32	[31, 33]
Malaysia	37	[34, 37]	36	[33, 37]	39	[38, 39]
Poland	38	[38, 39]	37	[36, 39]	41	[40, 41]
Hungary	39	[37, 39]	41	[39, 44]	37	[36, 37]

Figure 3.1: Metrics for quality of innovation: Top 10 high- and top 10 middle-income economies

High-income economies

| 1 United States of America |
| 2 Japan |
| 3 Switzerland |
| 4 Germany |
| 5 United Kingdom |
| 6 Sweden |
| 7 Korea, Rep. |
| 8 Netherlands |
| 9 Denmark |
| 10 Finland |
| **Average (48 economies)** |

Middle-income economies

| 16 China |
| 27 India |
| 28 Russian Federation |
| 29 Brazil |
| 30 Argentina |
| 32 South Africa |
| 34 Mexico |
| 38 Malaysia |
| 41 Turkey |
| 43 Thailand |
| **Average (62 economies)** |

Legend:
- 2.3.4 QS university ranking average score of top 3 universities
- 5.2.5 Patent families filed in at least 2 offices
- 6.1.5 Citable documents H index

Sum of scores

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Intelligence Agent

IBM (IBM, 2012):

intelligent agents as "**software** entities that carry out some **set of operations** on behalf of a user or another program, with some degree of **independence or autonomy**, and in so doing, employ some knowledge or representation of user's goals and desires".

IBM (2012), IBM's Intelligent Agent Strategy, white paper. http://activist.gpl.ibm.com:81/WhitePaper/ptc2.htm
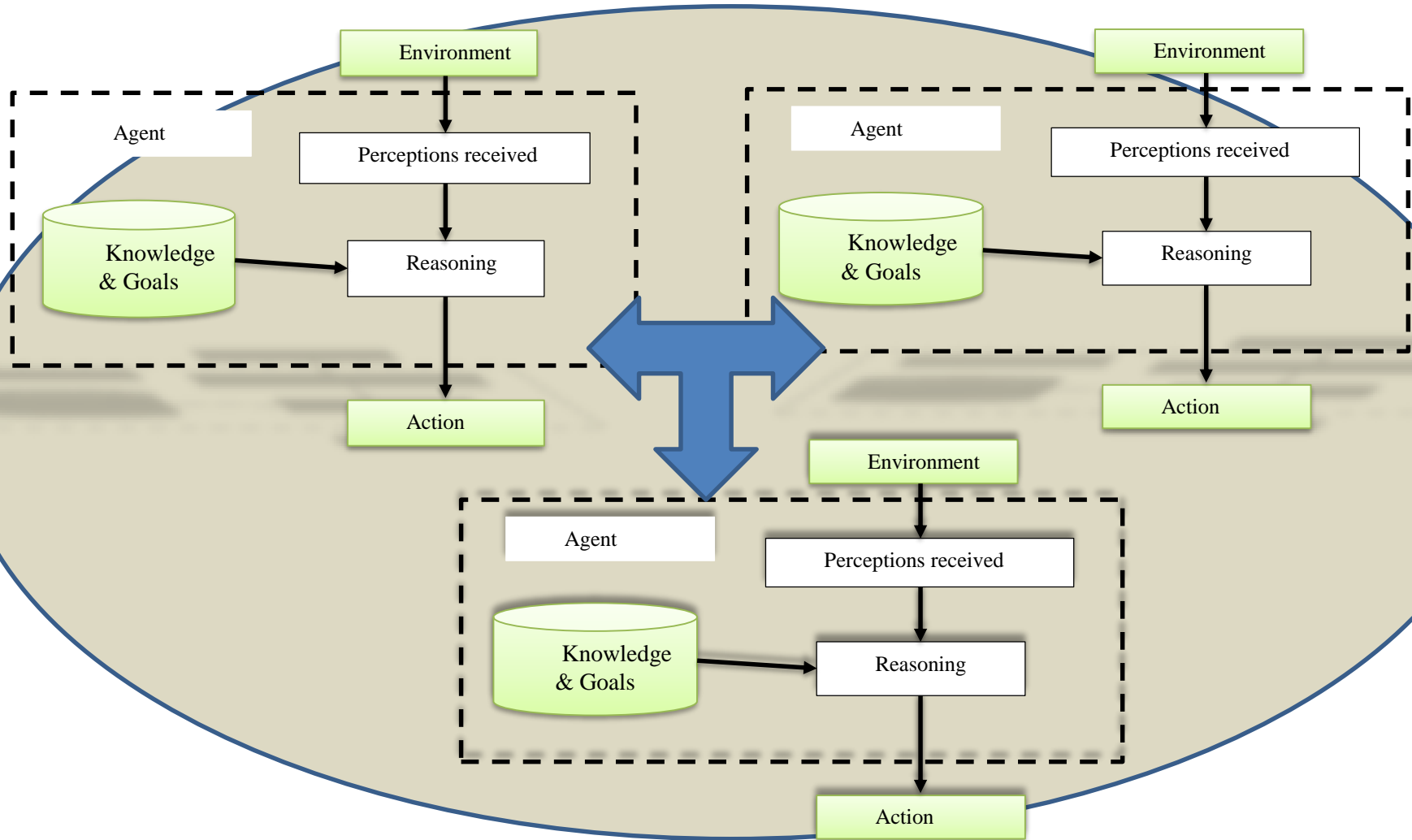
Intelligence Agent

Multi-agent system (MAS) is a **network of agents** that are reasoning (problem solvers) and cooperating, communicating and negotiating to achieve a specific task. Individual agents are able to adapt their behavior to the changing environment in which they work (Weyns, 2010).
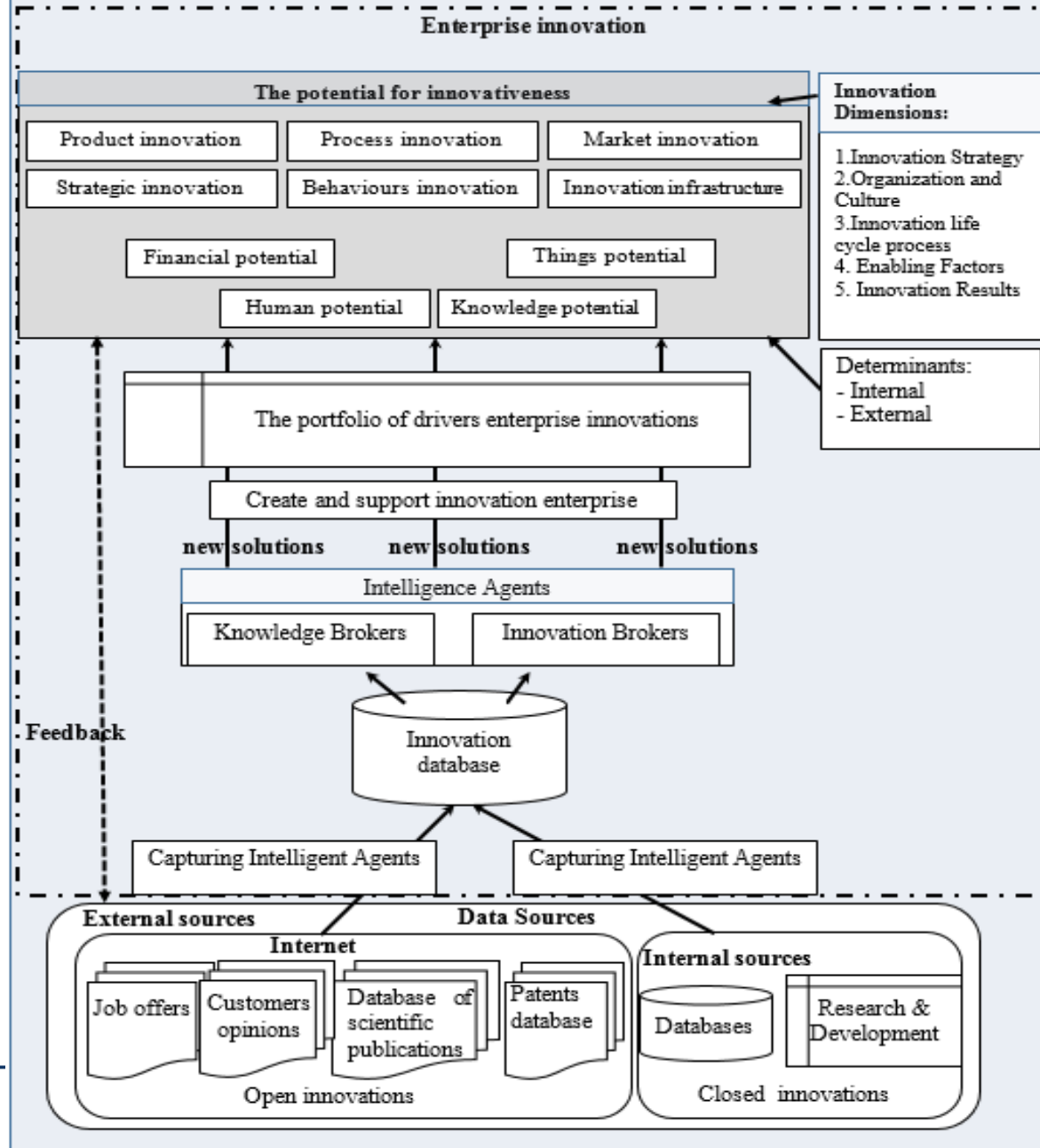
Weyns D. (2010) Architecture-Based Design of Multi-Agent Systems, Springer-Verlag, Berlin Heidelberg.

Intelligence Agent -> MAS

A Framework for Innovation Enterprise Support Based on Intelligence Agent Approach

Conclusion

Research domain
Theoretical framework: the support of enterprise innovation using intelligent agents.

Enterprise innovation

The potential for innovativeness

| Product innovation | Process innovation | Market innovation |
| Strategic innovation | Behaviours innovation | Innovation infrastructure |

Financial potential

Things potential

Human potential

Knowledge potential

Innovation Dimensions:
1. Innovation Strategy
2. Organization and Culture
3. Innovation life cycle process
4. Enabling Factors
5. Innovation Results

Determinants:
- Internal
- External

The portfolio of drivers enterprise innovations

Create and support innovation enterprise

new solutions   new solutions   new solutions

Intelligence Agents

Knowledge Brokers   Innovation Brokers

Innovation database

Feedback

Capturing Intelligent Agents   Capturing Intelligent Agents

External sources   Data Sources

Internet

Job offers | Customers opinions | Database of scientific publications | Patents database

Internal sources

Databases | Research & Development

Open innovations   Closed innovations

Thank You for Your Attention

Děkuji za pozornost

Dziękuję za uwagę
tomasz.bartus@ue.katowice.pl
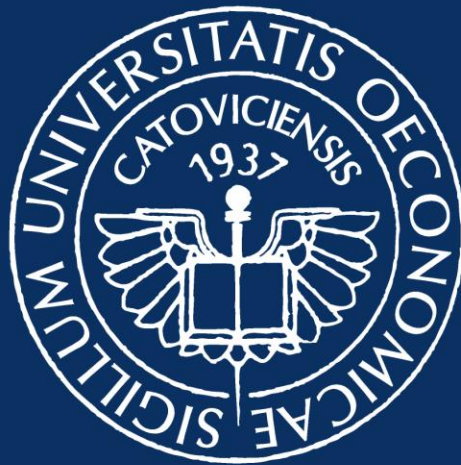
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