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ON THE RELATION BETWEEN THE INNOVATION INDEX AND THE READINESS FRONTIER TECHNOLOGIES INDEX, UNDER A HOLISTIC QUALITY MANAGEMENT APPROACH

Abstract. Innovation and technology have been related from the beginning of human society. The primary goal of this research was to determine the relationships between the innovation index and readiness frontier technologies index, under a quality management approach, since quality and quality management are important concepts nowadays and for the future. The research methodology was (1) collecting data and information on the innovation index and frontier readiness technology index worldwide, (2) describing the newly introduced ISO 56000 family of standards (ISO standards for innovation), (3) dealing with correlation and regression analysis (inferential statistics) for relationships between innovation index and frontier readiness technology index. This procedure resulted in the main outcome of this research that the relationships between innovation and technology statistically verified, are strong. Saying this, the general application of ISO standards and specifically, the ISO 56000 family of standards, combined with advanced technology, are necessary to achieve a competitive advantage. The key recommendation of the research is that the application of ISO standards and the application of the ISO 56000 family of standards in conjunction with technology advancement, help companies to strengthen their commitment to their customers, improve outcomes of innovation and knowledge & technology output activities, improve processes and procedures and economies around the world to gain a competitive advantage in response to the crisis and post-crisis.

Keywords: **innovation index**, readiness frontier technologies index, ISO 56000, quality management, life quality.

1. Introduction

Technology development requires innovation. It is considered that there is a substantial relationship between innovation and technology, and both are related to quality management too. This was the main question investigated in this study, which employed quantitative approaches in conjunction with regression analysis to investigate the correlations between the Innovation Index and Frontier Readiness Technology Index. There were previously separated existing data and materials about the innovation index and preparedness frontier technologies index, as well as previously published works and research publications, books, and online libraries. It is believed that scientific management,

including quality management, especially ISO 56000 family, which is related to innovation, combined with technology use, creates opportunities for achieving a competitive advantage. To achieve and maintain the competitive advantage, all interested parties, individuals, and public and private institutions, particularly decision-makers and civil society, must improve and maintain the relations between innovation and technology usage, to improve the quality of life for individuals and societies. When discussing innovation and technology we immediately think of innovative goods and services, new combinations thereof leading to improved ones, new methods of processing, manufacturing, and assembly, opening up new markets, a new way of using resources, innovative business models, etc., included. This is about the effectiveness and efficiency of processes, procedures, methods, methods, tools, and technologies involved in the production process of goods and services, as part of economic theory, especially in relation to theory. As a general concept, innovation includes innovation processes, structures required for the process, results of activities, previous variants of products/services, and relationships at the organizational level in private and public issues, including specific, regional, and cluster levels, as part of economic theory, particularly concerning factors of production, which should be materialized at the technology and technology usage. Technology accompanied by innovation and vice versa, does not always require invention, but simple practical implementation of problem-solving techniques and decision-making, implementation of ideas based on individual and group activities. There is currently an impressive drive and interest in innovation and technology, particularly in a culture of quality and ISO standards. The culture of quality serves as a guide for continuous improvement, belongs to all members of the organization (s), and also forms a link between internal customers and suppliers. They enshrine the core value of a quality culture in ISO standards, which are of increasing interest around the world to gain a competitive advantage. Between them, in particular the family of standards ISO 56000, directly related to innovation management, have been introduced during 2019, which also coincides with the time of the Covid-19 pandemic, are the most required standards. Innovation, technology output, quality, quality culture, quality culture management, and ISO standards are becoming an important part of achieving business models' competitive advantage, under the new reality and the new normal.

2. Literature review

At present, the literature on innovation, technology, quality, ISO standards, quality culture, etc. has been improved around the world, alongside the country and level of economic development. This is because concepts of innovation, knowledge, technological output, quality, quality management, and ISO standards when applied correctly, help private and public organizations to be more competitive in an open market when and where supply is much higher than demand. one of the main characteristics of the last 50 years of the global economy.

2.1 Innovation as we know it today

According to an OECD report, for about 35 years entrepreneurship has been defined as an attempt to use innovative aspects that involve the use of factors of production already involved, within the framework of a new approach to the use of productive capacity, with its core the realization and use of entrepreneurial resources and as an activity of creation that takes place and is completed along the way of the manufacturing process (Drucker, 1985, Ahmad. et al. 2007, Shane 2003). The OECD-Oslo Handbook Innovation was defined as the implementation of a new or significantly improved product (good or service) or process, a new marketing method, or a new organizational method in business practices, workplace organization, or external relations. In terms of economic theory, innovation is an industrial mutation that is progressively revolutionizing the economic structure from within, incessantly destroying the old one and incessantly creating a new one, which is a concept of today's global economic approach when skills, knowledge, and competencies are important.

According to the International Organization of Standards, innovation is a new or improved product or process that differs significantly from previous products or processes and is made available to users. This definition is consistent with those in ISO standards, so they can be useful tools for comparing and evaluating innovations within and between organizations (Schumpeter. 1942 & 1993. ISO 2019).

In the face of increasing global competition, global products, services, manufacturing processes, business models and markets, and the implementation of new technologies, it seems that the results of doing business are in the hands of productivity (effectiveness and efficiency) as well as in the hands of intense innovative activities, which have been considered as the main problems of the competitive advantage of doing business, as a process that arises through interactions between different actors and becomes issues of importance for the future of business and corporate success.

As described above, considering competitive advantage as the main driving force for business and entrepreneurial activities, innovation and technology usage should be considered as key factors that require physical and non-physical support for an optimal result. Innovation and technology are development tools that plays an increasingly important role in global trade. In the last two decades in particular, the arena of world trade has changed, with economies of scale gradually being replaced by an innovation economy focused on high-value-added products and services (GII. 2021).

2.2 Innovation as an ISO family of standards. ISO 56000

A large number of standards have been developed to help and support companies and public organizations to streamline their internal systems, processes, procedures, and records to have an open approach to innovative aspects and activities and to address any issues that contribute to the bottom line of operational activities of public and private entities that implement IMSs in innovative ways. Innovation serves as a

force that propels companies into a time and period of success. A family of standards with the number 56000 was published in 2019 on innovation and innovation management, which helps companies to manage innovations and innovative measures effectively and in a more structured way. Innovation is about creating something new that adds value; This can be a product, a service, a business model, or an organization. And the added value that is created is not necessarily of a financial nature, it can also be social or ecological. The ISO 56000 family will help organizations significantly improve their ability to survive in our changing and uncertain world. They enable organizations to constantly reinvent themselves (ISO. 2020. Naden. Feb 2020). The ISO 56000 family includes:

- 56000:2019 – Management of innovation – Innovation MS – Guidance
- 56002, Management of innovation – *Innovation MS – Guidance*
- 56003, Management of *innovation – partnership on innovation, methods, and tools – Guidance*
- 56004, Management of innovation – assessment – *Guidance*
- 56005, Management of *innovation – Int. Prop, Mngmt, Methods, and tools – Guidance*
- 56006, *Management of Innovation – SIM – Guidance*
- 56007, Management of innovation – *Management of ideas*
- 56008, Management of innovation – *IOM, methods, and tools – Guidance*

It is clear that even for the International Standards Organization the ties between innovation and creativity are strong, as the ISO 56000 family of innovation standards clearly expresses the connection by saying that the application of ISO standards in general and the Applying the ISO 56000 family of standards helps organizations strengthen their commitment to their customers, improve innovation and creativity activities, processes and procedures, and economies worldwide to gain a competitive advantage in response to crisis and post-crisis times.

2.3 Readiness frontier technology index

The United Nations Conference on Trade and Development (UNCTAD) published a report titled “Technology and Innovation” in 2022. The study is a valuable tool for guiding policies and strategies for leading-edge technology adoption. UNCTAD ranks countries’ economies in terms of their respective “Country-Readiness Index” in this report. The Index assesses economies based on their ability to use, adopt, and adapt “frontier technologies” equitably. The index is made up of five components, which are as follows (UNCTAD, 2022):

ICT Infrastructure Deployment – This is the level of ICT infrastructure. Using, adopting, and adapting cutting-edge technologies necessitates adequate ICT infrastructure, particularly as AI, IoT, big data, and blockchain are all internet-based technologies. Two components of ICT infrastructure must be considered: the prevalence

of access to ensure that no one is left behind, and the quality of infrastructure that allows for more advanced and efficient use. For these reasons, internet users as a percentage of the population reflect the presence of internet infrastructure, whereas mean download speed reflects the quality of the internet connection (UNCTAD, 2022).

Skills – Using, adopting, and adapting frontier technologies needs people equipped with relevant skills. These may be advanced but are generally lower than those required to originate the technologies. Two types of skills need to be considered: skills acquired through education and skills acquired in the workplace through practical training or learning by doing. The overall educational attainment of the population is measured through expected years of schooling, while the skill level in the labor market is measured by the extent of high-skill employment – defined by the ILO as the sum of managers, professionals, and technicians and associate professionals following the International Standard Classification of Occupations (ISCO). These indicators need to be interpreted with caution, especially in developing countries, because of the emigration of highly trained or skilled people, the “brain drain”, as a result of which the actual skill level could be lower than the official estimate (UNCTAD, 2022).

Research & Development – R&D work is required not only for the development of cutting-edge technologies but also for their adoption and adaptation, as these technologies frequently require adjustment or modification for local applications. The number of publications and patents filed on a country’s 11 frontier technologies is used to measure R&D activities. The publication and patent search queries used are identical to those described in the Technical note in Annex B, except for the year of interest, which is a single year for the index rather than 1996–2018. The authors’ and patent assignees’ countries of publication were investigated. It should be noted that there are informal R&D operations that may not result in a publication or patent, so the R&D scores may not reflect the actual scale of activities (UNCTAD, 2022).

Industry Activity – This building element intends to record ongoing industry actions relating to the use, adoption, and adaptation of cutting-edge technologies. It looks at three industries that are early adopters: manufacturing, with high-tech manufacturing leading the way; finance; and ICT, which interacts with other technologies. Then it employs export data on high-tech manufacturers as well as digitally deliverable services in finance and ICT. However, particularly in developing nations, operations are carried out by enterprises in the informal sector, which are frequently excluded from official statistics. As a result, the scores from these countries may be lower than the real activity (UNCTAD, 2022).

Finance – This analyzes the availability of private-sector finance. Better access to funding could hasten the use, adoption, and adaptation of cutting-edge technologies. Domestic credit to the private sector as a proportion of GDP was chosen as part of the index for this purpose. This statistic measures financial corporations’ resources, such as

finance and leasing companies, money lenders, insurance companies, pension funds, and foreign exchange companies. It also comprises a variety of financial instruments like loans, non-equity securities purchases, trade credits, and other accounts receivable. However, alternative, unorthodox finance providers or financial instruments may exist that are not adequately represented by this measure. And based on data for these five subindexes, the Readiness Frontier Technology Index was calculated (UNCTAD, 2022).

3. Research framework, the purpose of the case study

The research framework was the worldwide and global ecosystem linkages between the Innovation Index and Readiness Frontier Technologies Index.

Given the scarcity of numerical, statistical, and algebraic reasoning on the links between the Innovation Index and RFT Index, this study employs a theory-building technique to address the following research questions:

1. H_0 : There is not any connection/relation between Innovation Index and RFT Index.
2. H_1 : There is a strong connection/relation between Innovation Index and RFT Index.

4. Methodology

While acknowledging the significance of connections/relationships between readiness frontier technologies and ISO standards, particularly ISO 56000, Innovation management, prior empirical research does not explain statistically verified, if there is any connection/relationship between them; thus, theory development, supported by analysis and evidence, is required. The exploratory technique should be used in conjunction with a single-depth case study approach, which is ideal for building a full understanding of a phenomenon and allowing for a closer exploration of theoretical structures.

Case selection

The scenario was chosen based on three major criteria: a theoretical approach, the applicability of genuine beneficial impacts of relationships on the Innovation Index, and RFT Index links. The case project was separated into three stages: (1) identifying needs for innovation, (2) identifying needs for technology usage, and (3) identifying nations' rankings for Innovation and RFT.

Data collection

The data for the Innovation Index came from the GII Report 2022, an annual ranking of countries based on their innovation properties.

The RFT Index came from UNCTAD Report 2022.

Data analysis

Innovation and RFT ranking indicators were correlated and regressively analyzed (inferential statistics) in 128 countries worldwide.

The RFT Index (taken from the UNCTAD Report 2022) and the ISO 9001:2015 Index (created as indicated in the preceding paragraph) are mentioned in the table below.

I developed and ran a regression analysis between the Innovation index and RFT Index confirming the H1 hypothesis, “There is a strong relation between the Innovation Index and RFT Index, as opposed to the Ho hypothesis, “There is not a strong relation between the Innovation index and RFT Index.”

Table 1. – List of countries based on the Innovation Index and Readiness Frontier Technology Index

No	Country	Innovation Ranking	Readiness Ranking
1	2	3	4
1	Albania	84	85
2	Algeria	120	98
3	Argentina	73	65
4	Armenia	69	83
5	Australia	25	12
6	Austria	18	22
7	Azerbaijan	80	100
8	Bahrain	78	56
9	Bangladesh	116	112
10	Belarus	62	59
11	Belgium	22	11
12	Benin	128	139
13	Bolivia	104	116
14	B&H	75	80
15	Botswana	106	111
16	Brazil	57	41
17	Brunei Drsl	82	69
18	Bulgaria	35	51
19	Burkina Faso	115	148
20	Cabo Verde	89	101
21	Cambodia	109	113
22	Cameroon	123	132
23	Canada	16	14
24	Chile	53	49
25	China	12	25

1	2	3	4
26	Colombia	67	78
27	Costa Rica	56	61
28	Côte d'Ivoire	114	131
29	Croatia	42	52
30	Cyprus	28	34
31	Czech Republic	24	26
32	Denmark	9	10
33	Dominic. Rep	93	95
34	Ecuador	91	90
35	Egypt	94	87
36	El Salvador	96	106
37	Estonia	21	29
38	Ethiopia	126	150
39	Finland	7	17
40	France	11	13
41	Georgia	63	79
42	Germany	10	9
43	Ghana	112	103
44	Greece	47	38
45	Guatemala	101	104
46	Guinea	130	153
47	Honduras	108	122
48	Hong Kong (Ch)	14	15
49	Hungary	34	37
50	Iceland	17	30
51	India	46	43
52	Indonesia	87	82
53	Iran	60	71
54	Ireland	19	8
55	Israel	15	20
56	Italy	29	24
57	Jamaica	74	96
58	Japan	13	18
59	Jordan	81	64
60	Kazakhstan	79	62

1	2	3	4
61	Kenya	85	105
62	Korea RD	5	7
63	Kuwait	72	58
64	Kyrgyzstan	98	115
65	Laos	117	127
66	Latvia	38	40
67	Lebanon	92	63
68	Lithuania	39	39
69	Luxembourg	23	16
70	Madagascar	110	130
71	Malawi	107	137
72	Malaysia	36	31
73	Mali	124	141
74	Malta	27	35
75	Mauritius	52	77
76	Mexico	55	57
77	Mongolia	58	110
78	Montenegro	50	70
79	Morocco	77	76
80	Mozambique	122	149
81	Myanmar	127	121
82	Namibia	100	91
83	Nepal	111	109
84	Netherlands	6	6
85	New Zealand	26	23
86	Nigeria	118	124
87	NR Macedonia	59	73
88	Norway	20	19
89	Oman	76	74
90	Pakistan	99	123
91	Panama	83	67
92	Paraguay	88	102
93	Peru	70	89
94	Philippines	51	44
95	Poland	40	28

1	2	3	4
96	Portugal	31	32
97	Qatar	68	72
98	Moldova	64	81
99	Romania	48	45
100	Russia	45	27
101	Rwanda	102	133
102	Saudi Arabia	66	50
103	Senegal	105	118
104	Serbia	54	47
105	Singapore	8	5
106	Slovakia	37	36
107	Slovenia	32	33
108	South Africa	61	54
109	Spain	30	21
110	Sri Lanka	95	86
111	Sweden	2	4
112	Switzerland	1	2
113	Tajikistan	103	143
114	Thailand	43	46
115	Tanzania	90	138
116	Togo	125	129
117	Trnd&Tbg	97	75
118	Tunisia	71	60
119	Turkey	41	55
120	Uganda	119	128
121	UK	4	3
122	Ukraine	49	53
123	UAE	33	42
124	Uruguay	65	68
125	USA	3	1
126	Viet Nam	44	66
127	Yemen	131	156
128	Zambia	121	134
129	Zimbabwe	113	136

The graph below represents a graphical regression analysis that shows there is no strong connection/relationship between the RFT Index and the ISO 9001: 2015 Index.

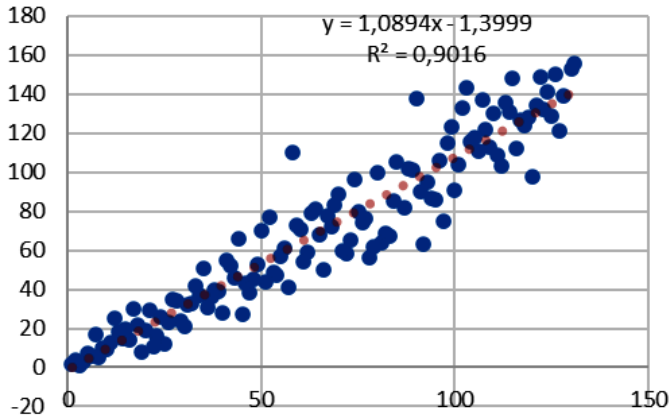


Diagrama 1.

The three tables that follow provide statistical information on the connections/relationships between the RFT Index and the ISO 9001:2015 index, with $R_2 = 0.12414$ suggesting a weak connection/relationship between these two indexes.

Table 2.

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.949576
R Square	0.9016
Adjusted R Square	0.900825
Standard Error	13.65795
Observations	129

Table 3.

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	217065.2	217065.2	1163.647	8.44E-66
Residual	127	23690.53	186.5396		
Total	128	240755.8			

Table 4.

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-1.39985	2.408806	-0.58114	0.562176	-6.16644	3.366741	-6.16644	3.366741
Innovation Ind.	1.089382	0.031935	34.11227	8.44E-66	1.026188	1.152576	1.026188	1.152576

These findings demonstrate that there is a strong connection/relationship between the Innovation index and Readiness Frontier Technology Index.

Theory and Practice Implications

Concerning the theory, based on the final results of this research, a new window has been opened for further research on the field of relationships between innovation and technologies usage, under a quality management approach, particularly between

the RFT Index and the ISO 56000 standards family (Innovation family), both of which are regarded as tools for improving life quality all over the world.

Limitations and further research

This study was conducted utilizing a large amount of Innovation Index data and RFT Index data and presenting for the first time statistics on the issue of these relations.

More study is needed to confirm that these relationships will be strengthened in the future, making Innovation and RFT real tools for achieving competitive advantage.

Conclusions and recommendations

1. Towards fixedness of natural resources and restrictions on boundless economic growth approach, the direction of innovation and technology usage and developments, and the output are important in overcoming resource constraints.

2. There is a tendency for innovations to save on scarce resources. If technological progress will be fixed-factor saving, then fixed factors may not be a large barrier to growth.

3. Achieving competitive advantage requires a positive approach towards innovation, technology usage, and quality management, requiring improvement of innovation, technology usage, quality management, and business climate in SMEs, seeing this as a general microeconomic perspective too, while, in a broader context, this study extends the general understanding of the innovation, technology usage and quality management relations to be used for a future managerial approach/mechanism in real-world situations, suggesting future research could focus on developing and validating the proposed framework and investigate the issue in more contexts and settings.

4. A connection between the innovation index and the readiness frontier technologies index has not only been demonstrated in theoretical aspects but verified by a regressive analysis and ISO 56000 family of standards helps companies to strengthen their commitment to their customers, innovation, and knowledge & technology output Improve activities, processes and procedures and economies around the world to gain a competitive advantage in response to crisis and post-crisis times.

5. The research concludes that all interested parties, including individuals, public and private institutions, decision-makers, and civil society, should strive for and maintain sustainable development scenarios by utilizing quality management principles and ISO standards as efficient and effective tools. As an immediate priority, all stakeholders should work to improve and maintain existing relationships and links between innovation and technology usage.

References:

1. Clare Naden (19 February 2020). Inspiring successful innovation with new international standards. ISO 2020. URL: <https://www.iso.org/news/ref2481.html>. Visited on 6th April. 2022
2. Drucker. P. Innovation and Entrepreneurship: Practice and Principles. – New York, USA: Harper Business. 1985.
3. Global Innovation Index Report 2021. (World Intellectual Property Organization, 14th Edition). URL: https://books.google.al/books?id=43FMEAAAQBAJ&redir_esc=y. Visited 6th April 2022.
4. Innovation management system. ISO 56002:2019 Innovation management system – Guidance. URL: <https://innovationmanagementsystem.com/portfolio-items/iso-56002-innovation-management-system-guidance/>. Visited 6th April 2022.
5. ISO Secretariat. October 2019. ISO and Innovation. ISBN978-92-67-11087-5. URL: <https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100444.pdf>. Visited 6th April 2022.
6. ISO. 2019. ISO 22301:2019 Security and resilience – Business continuity management systems –Requirements. Buy this standard This standard is available for free in read-only. URL: <https://www.iso.org/standard/75106.html/> Visited 6th April, 2022.
7. “ISO 56000:2020(en)Innovation management – Fundamentals and vocabulary”. ISO. 2020.
8. ISO 56002:2019. 2019. Innovation management – Innovation management system – Guidance. URL: <https://www.iso.org/standard/68221.html>. Visited 6th April 2022.
9. Nadim Ahmad, Richard G. Seymour. 2007. Defining entrepreneurial activity: Definitions Supporting Frameworks for Data Collection. URL: <https://www.oecd.org/sdd/business-stats/39651330.pdf>. DEFINING ENTREPRENEURIAL ACTIVITY: – OECD. Visited 6th April, 2022.
10. OECD, 1996. The Knowledge-Based Economy, OECD Paris.
11. OECD (2005). Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, OECD Publishing. ISBN92-64-01308-3, Paris, France.
12. Schumpeter Joseph A. Business Cycles. 1. p. 84. Innovation is possible without anything we should identify as an invention, and the invention does not necessarily induce innovation. 193.9
13. Schumpeter, Joseph. 1942. Capitalism, Socialism, and Democracy.
14. UNCTAD. 2022. Technology and Innovation Report. URL: <https://unctad.org/tir> 2023. Visited on 3rd July, 2023.