Industry 4.0 readiness assessment tool: a conceptual framework from social well-being perspective

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Abstract: Industrial Revolution 4.0 (IR 4.0) adoptions have a positive effect on many facets of human life, including the economy and culture, such as income growth and living standards. Nevertheless, it will also have a negative effect on society, especially the social well-being that needs to be studied and explored. Thus, the purpose of this study is to develop a conceptual framework for an evaluation method to assess the degree of readiness of employees for IR 4.0 from a social well-being perspective. This paper used a search engine optimization (SEO) approach using related keywords from google suggest results as a guidelines and content analysis strategy based on the first three pages of results accessed during the identification phase based on PRISMA systematic methodology to review existing model. The review identifies 59 social well-being models with different dimensions. This study proposes five dimensions as the most important social well-being perspectives for organizations namely social integration, social acceptance, social contribution, social actualization and social coherence. It is expected that the establishment of the assessment tool can be used to measure the readiness of employees to face challenges of IR 4.0.

Keywords: Social Well-being, Industrial Revolution 4.0, Readiness Assessment Tool, Systematic Literature Review.

1. Research background

Industry Revolution 4.0 is an age in which, via computer systems, the Digital Revolution links entities and machines, allowing them to send and receive data over a network in order to facilitate mass production that is highly versatile, individualized and resource-friendly (Hammoudi et al., 2018; Ślusarczyk, 2018). The word Industry 4.0 originates from the German Government's high-tech plan, which aimed to redefine the position of the global eco-friendly manufacturing post that suggest the 4th Industrial Revolution, a cyber physical age, which will be realised over the next 20 years (Zhong et al., 2017). This would make mass manufacturing extremely scalable, personalized and sustainable, motivated by a desire for shorter economy of scale, greater efficiency and greater utilization of available resources and motivated by a shorter time-to-market requirement, improved flexibility and greater utilization of properties. (Hamidi et al., 2018). Social well-being, in nature, allows us to maintain active and purposeful social lives that strengthen and maintain our sense of well-being. The growth of Industry 4.0 creates tremendous opportunities for sustainable development to be realized and has a direct impact on the manufacturing industry. It focuses on the growth of smart manufacturing, smart products and smart services, also referred to as the industrial internet, incorporated into the IoT technology and Assistance (Shrouf et al., 2014).

More fundamentally it will create new aspect of social well-being and changes to the way in which we do business today. Based on research at the University of Warwick, an Industry 4.0 readiness assessment tool has been developed More importantly, new facets of social well-being and improvements to the way we do business today will be made. An Industry 4.0 readiness evaluation tool (WMG, 2017) to provide a simple and intuitive way for companies to start to assess their readiness and future ambition to harness the potential of the Internet generation In its essence, the readiness assessment method is systematic and looks beyond the technology to take into account six core dimensions with 37 sub-dimensions of sector 4.0 readiness (WMG, 2017).

In nature, social beings imperative that we maintain active and purposeful social lives which enhance and preserve our sense of well-being. Therefore, a social well-being evaluation tool is

important for businesses to evaluate the readiness level of their workers in order to comply with government initiatives towards Industry 4.0.

2. Literature review

2.1. Industrial revolution

In the early industrialized countries, industrial value creation is currently formed by growth towards the fourth stage of industrialization, called Industry 4.0, which creates enormous potential for sustainable development to be realized (Stock & Seliger, 2016). Moreover, the development towards Industry 4.0 has presently a substantial influence on the manufacturing industry (Lee et al., 2015). It is focused on the development of industrial automation, smart goods and smart systems incorporated into the Internet of Things and Technology, also known as the Industrial Internet (Stock & Seliger, 2016). Additionally, Industry 4.0 also includes multiple technologies, equipment communications network, cyber - physical systems, automation, machine learning, business analytics, and many other fields of cloud technology. (Schumacher et al., 2016).

The Malaysian government is aggressively undertaking various efforts to help market players embrace Industry 4.0 through automation and smart technology development to match with global growth (Ministry of International Trade and Industry, 2020). In conjunction, with the National Industry 4.0 Strategy, the Government has launched the 11th Malaysia Plan, which will accelerate the acceptance of Industry 4.0 technological innovations (Ariffin et al., 2020; Bahrin et al., 2016). Moreover, many programs have been developed and organized for industry player to ensure Malaysian Industry remains competitive in the global market. In the recent 2018 Budget, the government highlighted many competitive reward incentives to fuel the growth and adoption of Malaysia's smart industrialization 4.0 (Premkumar & Dashveenjit, 2018).

Simultaneously, intensify and effort of government with the Industry 4.0 initiative, give an impact not only to the industry itself but also to the employees. Employees are important assets or resources of the industry. According to Nagy, Oláh, Erdei, Máté, and Popp (2018), the impact of Industry 4.0 on human activity will be very significant. It is believed that Industry 4.0 will formulate an influence to the well-being of employees. Technology (i.e. IoT) will take over several workers, both in the blue and white-collar divisions, and as computers begin to organize themselves to provide work, the operational structures in the industries will also shift (Nagy et al., 2018). The vast gap between what is taught and the skills required by workers is among the key implications for this. In addition, according to Human Resources Development Fund (HRDF) chief executive, most of the 15 million private sector Malaysian employees need to be educated or trained to be multi-skilled in order to meet the demands of rising workplace digitalization (The Star, 2017). Employees need to change according to the industry change. The changes definitely will have an effect on their   especially in term of social dimension.

Despites of emergent industries to align with government effort in Industry 4.0, it is also essential to recognize the well-being and readiness of employees. Employees' well-being in the consequences of Industry 4.0 is imperative because it is associated with employee performance. The readiness of employee to cope with any issue relates to Industry 4.0 should be given more attention to ensure the sustainable of employee performance which in turn will increase company performance and ensure successful of government imitative to become high income nation. Over the years, a rising number of researchers are trying to understand and reason for factors that impact and constitute well-being and employee success potential. (Mohammad et al., 2016).

2.2. Well-being

The status of a person or community, such as their societal, religious, emotional, financial or healthcare situation, is defined as well-being or welfare (Mohammad et al., 2016). Well-being, in other words, is a healthy physical, social and mental condition that arises from mutual resources and relationships with individuals and locations (Naslund et al., 2016). It includes conditions that include positive professional relationships, community empowerment, economic stability, pleasing

jobs, good health, and a safe and attractive atmosphere to meet and reinforce basic requirement. (Bakar et al., 2016). The Malaysia Economic Planning Unit (EPU), which prepared the Malaysia Well-being Report, described well-being as the physical, social and economic benefits that have contributed to improving the quality of life and satisfaction of a person, family and society (Bakar et al., 2016).

To systematically measure the progress of Malaysia, the Malaysia Well-being Index (MWI) was created with the goal of improving and improving the current quality of life in Malaysia and of achieving more detailed social indicators to measure national progress (Bakar et al., 2016). However, there is no comprehensive indicator to access of employee readiness towards Industry 4.0 in Malaysian perspective and it is important to balance to create truly happy Malaysian employees (Bakar et al., 2016; Dali et al., 2017).

2.3. Social well-being

Social well-being is defined as the ability of a community to meet the necessary human needs of the population, create the foundations that enable individuals and communities to improve and sustain the well-being, and set the environment for all people to overcome challenges (Bakar et al., 2016). Housing, leisure, governance, public safety, social participation, culture, health, environment and family are the components of social well-being (Bakar et al., 2016). The social well-being aspect of Industry 4.0 will give named employees several advantages, such as enhanced learning process through smart and automatic systems and interfaces with technology that lead to increased job satisfaction in industrial workplaces (Müller et al., 2018). However, Muller et al. (2018) also pointed out that existing literature cannot provide a unified viewpoint on whether an increase or decrease in the number of workers in the industry would be induced by Industry 4.0.

2.4. Readiness assessment tool

In order to ensure that businesses are able to fully leverage and optimize the technology, it is important to evaluate how well companies are digitally equipped for Industry 4.0 technologies. The Industry 4.0 readiness evaluation is stated to be part of the 2019 budget steps to promote the implementation of Industry 4.0, and a total of RM210 million has been allocated to finance this initiative from 2019 to 2021 (The Star, 2018). Therefore, it is significant to establish measurement to assess readiness of employees to face challenges of Industry 4.0 and the indicator is crucial because it will become the government's benchmark for formulating policies and promoting initiatives to achieve a high-income, prosperous and inclusive nation. In order to perform better, industry and the academic community have made nonstop efforts to develop and re-create self-assessment models that can test the readiness of companies for Industry 4.0 (Schumacher et al., 2016). Organizations can then have two terminal states, the least ready or the most ready, depending on the models (Hizam-Hanafiah et al., 2020). In recent years, a range of readiness models have been developed by researchers from academia and industry for Industry 4.0. Figure 1 displays the 30 Industry 4.0 Readiness Model from different authors and founders based on 97 papers published from 2000 to 2019 in peer-reviewed academic journals and industry reports with 158 basic model dimensions using the methodology of systematic literature review (SLR) (Hizam-Hanafiah et al., 2020).

No.	Model Name	Year	Academia/Industry
1	Industry 4.0 Readiness Evaluation for Manufacturing Enterprises	2018	Academia
2	Industry 4.0 Maturity Model	2018	Academia
3	Future Readiness Level (FRL)/Industry 4.0 Future Readiness	2018	Academia
4	E-Business Industry 4.0 Readiness Model	2018	Academia
5	Benchmarking Readiness I4.0	2018	Industry
6	SMEs Maturity Model Assessment of IR4.0 Digital Transformation	2018	Academia
7	Readiness for Industry 4.0	2018	Academia
8	SSCM Assessment for Industry 4.0	2018	Academia
9	Industry 4.0 Business Model Innovations Tool	2018	Academia
10	Industry 4.0 Maturity Model	2018	Industry
11	Manufacturing Companies Industry 4.0 Adoption Model	2018	Academia
12	BMS Smart Industry Research Roadmap (Behavioral, Management, Social Sciences)- SIRM	2018	Academia
13	ACATECH Industrie 4.0 Maturity Index	2017	Industry
14	Enterprise 4.0 Assessment	2017	Academia
15	Industry 4.0 Maturity Model- SPICE (Software Process Improvement and Capability dEtermination)	2017	Academia
16	Industry 4.0 Readiness Model for Tool Management	2017	Academia
17	Three Stages Maturity Model in SME's towards Industry 4.0	2016	Academia
18	Design Business Modelling for Industry 4.0	2016	Academia
19	SIMMI 4.0–System Integration Maturity Model Industry 4.0	2016	Academia
20	Industry 4.0 Introduction Strategy	2016	Industry
21	Roadmap Industry 4.0	2016	Academia
22	Assessment Model for Organizational Adoption of Industry 4.0 Based on Multi-criteria Decision Techniques	2016	Academia
23	Industry 4.0 Maturity Model	2016	Academia
24	Reference Architecture Model for the Industry 4.0 (RAMI4.0)	2015	Academia
25	Industry 4.0 Hindering Factors Model	2015	Industry
26	IMPULS—Industrie 4.0 Readiness	2015	Industry
27	Industry 4.0 Barometer	2014	Industry
28	Roland Berger Industry 4.0 Readiness Index	2014	Industry
29	Fraunhofer Industrie 4.0 Layer Model	2013	Industry
30	Industry 4.0 Readiness Model for Manufacturing	2006	Academia

Figure 1. 30 Industry 4.0 Readiness Models
(Source: Hizam-Hanafiah, Soomro & Abdullah, (2020))

The researchers suggested six dimensions (Technology, Individuals, Policy, Leadership, Process and Innovation) based on Figure 1, which can be regarded as the most important dimensions for organizations. Their analysis shows that 70 (44 percent) of the total 158 specific dimensions of Industry 4.0 apply to technology evaluation alone (Hizam-Hanafiah et al., 2020). Therefore, this research study proposed to establish an assessment tool to measure the readiness level of employees towards Industry 4.0. It is also proposed to investigate the dimensions of social well-being of the employees as important indicators to support companies' objectives towards Industry 4.0.

3. Methodology

To add to the current body of knowledge on Industry 4.0 readiness assessment tool for social well-being, a search engine optimization (SEO) approach based on many related keywords such as social well-being dimensions for industry 4.0 was used to see related findings from the Google Suggest and Google Scholar web applications. The technique is particularly helpful as it optimizes website that achieve higher ranking in search engines' organic results. This approach is adapted as it shows a top result for searchers of a certain keyword thus showing the popular models of social well-being that have been viewed by netizen either academicians or other categories of users. To find related keywords, google trend have been applied for searching more social well-being models and have higher hits of viewers. These approach delivers the most relevant models, faster and in formats that are most helpful to the type of information we seek. For structural methods, we adapt Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) to review existing models to be implemented or modified for the research, as shown in Figure 2 (Moher et al., 2011).
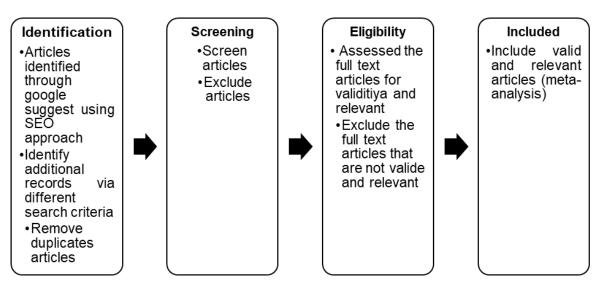
Figure 2. PRISMA flowchart, adapted from Moher et al., (2011)

Content analysis has further supported the approach, as it is also preferred for data analysis in the social sciences. Content analysis can be described as a structured method in which certain terms (codes) are summarized within categories in a text (Elo & Kyngäs, 2008). Search boundary and keyword used for scanning the results shown in Table 1 while for inclusion and exclusion criteria depicted in Table 2.

Table 1. Search boundary and keyword

Search boundary	Google Suggest
Keywords search	Social Well-being dimensions, Social well-being dimensions for industry 4.0

Table 2. Inclusion and exclusion criteria

	Inclusion	Exclusion
Literature Type	Indexed journals, chapters, conference proceeding, industry reports	Non-indexed journals, magazine articles
Language	English	Non-English
Timeline	Between years 2000 and 2020	Before year 2000

4. Results

Following the research objective of this paper, several targeted articles on social well-being dimensions related to industry 4.0 have been selected and analysed. Then, the most related dimensions to the industry 4.0 selected as shown in Figure 3. We adapted the model proposed by Keyes (1998) as cited by Lages et al. (2018).
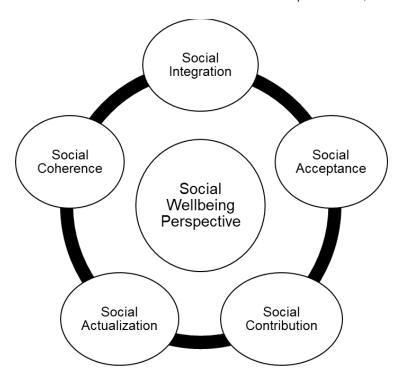
Figure 3. Social Well-being Perspective for Industry 4.0 Readiness Assessment Tool, adapted from Keyes, 1998 as cited in Lages et al., (2018)

4.1. Conceptual framework

The main objective of this study is to develop a conceptual framework that will enable a firm to assess its Industry 4.0 Readiness. Several attempts to create industry 4.0 readiness frameworks have been made in recent years, and these have been popularly referred to as "maturity models" or "readiness models" (Anbumozhi et al., 2020). Figure 4 depicts the conceptual framework for Industry 4.0 readiness assessment tool based on social well-being perspective proposed for this study. There are five elements of social well-being perspective adapted from Keyes (1998) namely social integration, social acceptance, social contribution, social actualization and social coherence to measure the firm's industry 4.0 readiness level. Readiness is often characterised as the ability to seize future production opportunities, mitigate risks and challenges, and respond to uncertainty with resilience and agility in which different approaches to assessing readiness, both for countries and individual businesses, use different qualitative and quantitative key indicators (Anbumozhi et al., 2020). Another framework that measure the Industry 4.0 Readiness social impacts such as environment, education and health refers to the World Economic Forum Networked Readiness Index (2016) as cited in Anbumozhi et al. (2020).
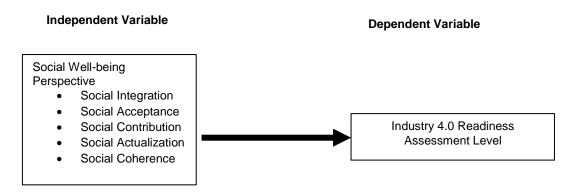

Figure 4. Conceptual Framework for Industry 4.0 Readiness Assessment Tool based on Social Well-being perspective

The frameworks measure the interest in promoting assessment of social well-being in addition to psychological, emotional well-being and the brief explanation about each element depicted in Table 3.

Table 3. A social well-being approach by Keyes (1998)

Social well-being elements	Explanation
Social Integration (feeling as a part of the community)	Sense of belonging to a community, from which one derives comfort and support
Social Acceptance (accepting others as they are)	Positive attitude towards others while acknowledging and accepting people's differences
Social Contribution (a feeling that one has a contribution to make to society)	Feeling that one's life is useful to society and the output of one's own activities are valued by or valuable to others
Social Actualization (positive comfort level with society)	Belief in the potential of people, groups and societies to evolve or grow positively
Social Coherence (understanding the social world as predictable comprehensible)	Interest in society or social life; feeling that society and culture are intelligible, somewhat logical, predictable, and meaningful

Source: Blanco and Diaz (2007)

5. Conclusions

Readiness for Industry 4.0 is a critical concern in the management and alignment of emerging technologies. This study reviews several existing social well-being perspectives related to the Industry 4.0 readiness models from both academia and industry. Furthermore, the analysis discusses multiple model dimensions used by various writers and companies to measure social well-being. Five dimensions adapted from existing model by Keyes, (1998) as cited in Lages, (2018) which include social integration, social acceptance, social contribution, social actualization and social coherence that can be considered as the relevant dimensions for the organizations to measure the industry 4.0 readiness as assessment tool for social well-being perspective.

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REFERENCES

1. Anbumozhi, V., Ramanathan, K. & Wyes, H. (2020). *Assessing the Readiness for Industry 4.0 and the Circular Economy*. Economic Research Institute for ASEAN and East Asia (ERIA).

2. Ariffin, A. S., Puteh, M. & Bizanjo, M. G. (2020). A*ligning Core Competencies with Malaysiaâ€™ s Industry 4.0 Policy Aspirations.* The Journal of Social Sciences Research, 6(12), 1001-1012.

3.   Bahrin, M. A. K., Othman, M. F., Azli, N. H. N. & Talib, M. F. (2016). I*ndustry 4.0: A review on industrial automation and robotic*. Jurnal Teknologi, 78(6-13).

4.   Bakar, A. A., Osman, M. M., Bachok, S. & Ibrahim, M. (2016). *Investigating rationales of Malaysia quality of life and well-being components and indicators*. Procedia-Social and Behavioral Sciences, 222, 132-142.

5.   Blanco, A. & Díaz, D. (2007). *Social order and mental health: A social well-being approach*. Psychology in Spain, ISSN 1137-9685, No. 11, 2007, 61-71, 11.

6.   Dali, N. M., Sarkawi, A. A. & Abdullah, A. (2017). *An Analytical Study of Malaysia's Quality of Life Indicators*. Population, 7(6,452.5), 6, 452-455.

7.   Elo, S. & Kyngäs, H. (2008). *The qualitative content analysis process*. Journal of advanced nursing, 62(1), 107-115.

8.   Hamidi, S. R., Aziz, A. A., Shuhidan, S. M., Aziz, A. A. & Mokhsin, M. (2018). *SMEs Maturity Model Assessment of IR4.0 Digital Transformation*.

9.   Hammoudi, S., Aliouat, Z. & Harous, S. (2018). *Challenges and research directions for Internet of Things*. Telecommunication Systems, 67(2), 367-385. https://doi.org/10.1007/s11235-017-0343-y.

10. Hizam-Hanafiah, M., Soomro, M. A. & Abdullah, N. L. (2020). *Industry 4.0 readiness models: a systematic literature review of model dimensions*. Information, 11(7), 364.

11. Keyes, C. L. M. (1998). *Social well-being*. Social psychology quarterly, 121-140.

12. Lages, A., Magalhães, E., Antunes, C. & Ferreira, C. (2018). *Social well-being scales: validity and reliability evidence in the Portuguese context*. Social well-being scales: validity and reliability evidence in the Portuguese context(2), 15-26.

13. Lee, J., Bagheri, B. & Kao, H.-A. (2015). *A Cyber-Physical Systems architecture for Industry 4.0-based manufacturing systems*. Manufacturing Letters, 3, 18-23. https://doi.org/https://doi.org/10.1016/j.mfglet.2014.12.001.

14. Ministry of International Trade and Industry (2020). *National Industry 4.0 Policy Framework*. https://grp.miti.gov.my/miti-grp/resources/Public%20Consultation/Industry4.0 FrameworkLayout_PublicReview(9Feb)V3_.pdf.

15. Mohammad, S. A., Dom, M. M. & Ahmad, S. S. (2016). *Inclusion of social realm within elderly facilities to promote their well-being*. Procedia-Social and Behavioral Sciences, 234, 114-124.

16. Moher, D., Altman, D. G., Liberati, A. & Tetzlaff, J. (2011). *PRISMA statement*. Epidemiology, 22(1), 128.

17. Müller, J. M., Kiel, D. & Voigt, K.-I. (2018). *What drives the implementation of Industry 4.0? The role of opportunities and challenges in the context of sustainability*. Sustainability, 10(1), 247.

18. Nagy, J., Oláh, J., Erdei, E., Mate, D. & Popp, J. (2018). *The Role and Impact of Industry 4.0 and the Internet of Things on the Business Strategy of the Value Chain - The Case of Hungary*. *Sustainability*, *10*, 3491. https://doi.org/10.3390/su10103491.

19. Naslund, J., Aschbrenner, K., Marsch, L. & Bartels, S. (2016). *The future of mental health care: peer-to-peer support and social media*. Epidemiology and psychiatric sciences, 25(2), 113-122.

20. Premkumar, P. & Dashveenjit, K. (2018). *Industry 4.0 National Policy to be Launched* (The Malaysian Reserves, Issue. https://themalaysianreserve.com/2018/04/06/industry-4-0- national-policy-to-be-launched/.

21. Schumacher, A., Erol, S. & Sihn, W. (2016). *A maturity model for assessing Industry 4.0 readiness and maturity of manufacturing enterprises*. Procedia CIRP, 52, 161-166.

22. Shrouf, F., Ordieres, J. & Miragliotta, G. (2014). *Smart factories in Industry 4.0: A review of the concept and of energy management approached in production based on the Internet of Things paradigm*. 2014 IEEE international conference on industrial engineering and engineering management.

23. Ślusarczyk, B. (2018). *Industry 4.0-are we ready?* Polish Journal of Management Studies, 17. https://doi.org/10.17512/pjms.2018.17.1.19.

24. Stock, T. & Seliger, G. (2016). *Opportunities of Sustainable Manufacturing in Industry 4.0.* Procedia CIRP, 40, 536-541. https://doi.org/https://doi.org/10.1016/j.procir.2016.01.129.

25. The Star. (2017). *Industry 4.0: The future is here*. Retrieved 25 November 2020, from https://www.thestar.com.my/ opinion /columnists/along-the-watchtower/2017/09/06/industry-40-the-future-is-here- malaysia-cannot-afford-to-lag-in-a-world-facing-swift-exponential-cha/.

26. The Star. (2018). *Industry 4.0 Blueprint on readiness assessment finalised*, says MITI. https ://www.thestar.com.my/business/business-news/2018/11/15/industry-40-blueprint-on-readiness-assessment-finalised-says-miti/#SePuZv64aimy1dLm.99.

27. WMG, U. o. W. (2017). *Industry 4: How ready is your business?* (Supply Chain in Practice, Issue. https://i4ready.co.uk.

28. Zhong, R. Y., Xu, X., Klotz, E., & Newman, S. T. (2017). *Intelligent Manufacturing in the Context of Industry 4.0: A Review*. Engineering, 3(5), 616-630. https://doi.org/https://doi.org/10.1016/J.ENG.2017.05.015.

APPENDIX

Social Well-Being Scales, adapted from Keyes (1998) as cited in Lages et al., (2018).

1. Social Integration
   - You feel like you're an important part of your community
   - If you had something to say, you believe people in your community would listen to you
   - You feel close to other people in your community
   - You see your community as a source of comfort
   - You believe other people in society value you as a person

2. Social Acceptance
   - You think that other people are unreliable*
   - You feel that people are not trustworthy*
   - You think that people live only for themselves*
   - You believe that people are more and more dishonest these days*

3. Social Contribution
   - Your daily activities do not produce anything worthwhile for your community*
   - You don't have the time or energy to give anything to your community*
   - You feel you have nothing important to contribute to society*

4. Social Actualization
   - You believe that society has stopped making progress*
   - Society isn't improving for people like you*
   - You don't think social institutions like law and government make your life better*
   - For you there's no such thing as social progress*

5. Social Coherence
   - The world is too complex for you*
   - You cannot make sense of what's going on in the world*
   - Most cultures are so strange that you cannot understand them*

   Items reversed.

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