I. ABSTRACT

This report is a summary of change readiness index result and E-Voting readiness index. The readiness index is measured using a number of different components as a measuring tool. And the goal of E-Voting readiness index is to analyze and compare the environment for the E-Voting. The report also presents a case study summary of E-Voting failure in Netherlands and its successful implementation in Estonia. And a quantitative way of exploring technology acceptance is discussed by studying the use of technology adoption curve.

II. INTRODUCTION

The progress of a nation undergoing digital transformation and automation can be demonstrated by its digital and automation readiness - in other words, how digitally ready a country is positioned to benefit from the internet economy and whether it is digitally inclusive as a society. In this report, we show the summary of previously performed automation readiness index results. And the components based on which the index results are calculated. The reports show that countries who have started their digital transformation early, stand out as the most digitally ready today and are also positioned to reap towards automation in the long term.

In addition to the automation or change readiness index, we also looked at the E-Voting readiness index. Electronic voting (E-Voting) is one of the best practices in electronic governance (E-Governance). To know about the E-Voting index result, it is important to know which countries have more experience in technology use in public and private enterprises, previous use of E-Voting in elections, and citizens participation in E-Voting. As an example, Estonia has a leading position in the development of E-Government and Internet-Voting tools, having aroused the interest of many scholars trying to understand the adoption of these tools by citizens [1].

In the following sections and sub-sections we will discuss the overview of automation and digital readiness index of different countries. The summary E-Voting readiness index and why E-Voting is no longer supported in Netherlands. In the final section, we also show some qualitative way of technology adoption curve using Moore’s Law.

III. THE AUTOMATION AND DIGITAL READINESS INDEX OVERVIEW

The purpose of the index is to collect key data that provides a better understanding of a country’s ability to face and benefit on change, this can help the stakeholders - including government, public and private enterprises, policy makers, NGOs, and civil society - identify and address capability gaps and make informed investment decisions that will strengthen a country’s readiness for change and benefit for all its citizen. In addition, readiness index is used to benefit different users including agencies, private and public enterprise, NGOs, and other funders who wants to understand a country’s need and prioritize their program accordingly such that their interventions are focused on identified demands [2, p. 11]. It is, therefore, important to determine the automation readiness of a country through which we can measure the preparedness of a country for any coming intelligent automation [3].

According to the automation readiness index report published by the Economist Intelligence Unit - the research model contained the result of 52 qualitative and quantitative indicators. The automation readiness index can be measured on three main categories: innovation environment, education policies, and labor market policies [3]. First, the innovation policies and entrepreneurship together constitute an innovative environment. These are the main factors that promote a society towards the development of new technologies and supporting individuals and business. Subsequently, as innovation develops, new skills should be developed in parallel to complement technology. Automation itself will create new jobs and will require upgraded skills, which evolves to a continuous learning, making education policy an important index where education policies are a range of policies that include improvement in the quality of education and development of human capital to provide such skills. Finally, the labor market policies facilitate the mobility of workforce across sectors, the transition from training to employment as well as the creation of new form on employment [3, p. 23].
The index provided a snapshot of 25 countries that anticipated the results of current government-led efforts toward technological progress shown in Fig 1. The 25 countries are the high-income, upper-middle-income and lower-middle-income countries. The overall index, based on innovation environment, education policies, and labor market policies ranked the countries on a scale of mature, developed and emerging. There are five countries that appeared at the top or mature level, South Korea, Germany, Singapore, Japan, and Canada ranking 1 to 5 respectively. These countries are the high-income countries that dominated each of the index categories. Estonia is chosen based on the advances in digitalisation and possessing experience in technology. Estonia ranks 6th in the overall index while ranking 7th under the labor market policies, 2nd in the education policy, and 12th in the innovation environment category being among the list of developed countries [3, p. 12]. The study shows that countries with better policies are capable of change automation and are also suitable choices for business investors.

Another study by the Cisco Australian Digital Readiness Index assessed the global digital readiness through the following components [4, p. 6]:

- Technology infrastructure: available to enable digital activities and connected consumers
- Technology adoption: the demand for digital products and services
- Human capital: build and maintain a skilled labor force to support digital innovation
- Basic human needs: for a population to survive and thrive
- Ease of doing business: basic infrastructure/policies needed to support business continuity
- Business and government investment: private and public investment in innovation and technology
- Start-up environment: an environment which fosters innovation with continuity.

Cisco identified the strongest components for digital automation, which includes human capital, basic human needs, technology infrastructure, technology adoption and ease of doing business. The remaining components are also crucial for digital automation. However, it is important to consider all the components for a long-term success. This index was developed to explore the global digital readiness of 118 countries with additional study and investigations of Australia’s states and territories.

In addition to that, a survey on change readiness index was performed by KPMG across 136 countries prioritizing countries with larger populations and with strong data availability. The survey was performed to indicate the capability of a country - its government, private and public enterprises, people, and civil society - to anticipate, prepare for, manage, and respond to a range of change drivers, proactively cultivating the resulting opportunities and mitigating potential negative impact [2, p. 5]. According to the survey results, the top five countries from rank 1 to 5 are Switzerland, Sweden, United Arab Emirates, Singapore, and Denmark, respectively. These countries ranked highest in the three pillars of change readiness index i.e. enterprise capability, government capability, and people and civil society capability. The five lowest ranking countries are four Sub-Saharan African countries and Syria.

As discussed, knowing a country’s level of preparedness before introducing any technological change is highly important. The readiness index results provides a general understanding of the automation level of country or organizations.

1KPMG is a global network of independent member firms offering audit, tax, and advisory services.
The components based on which any readiness index is calculated can differ from country to country. It depends on the current situation of that country but generally, existence of strong policies, such as, education policies, innovation policies, legislative support and opportunities for public and private to investments in technology are some of the main components in any readiness or digitalization index.

A. E-Voting Readiness Index

The usage of information and communication technology (ICT) has increased in the electoral process around the world. It is through the use of ICT that enables people to vote from their home and enabling election administrators conduct electronic electoral registers. In this section, the E-Voting readiness index of all the states of Europe with some additional countries who have E-Voting experience is presented, which is performed by Krimmer and Schuster [5]. The Krimmer and Schuster implemented two E-Voting methodologies. First, contextual model to identify the necessary dimensions and second, a methodology to assess the countries.

The contextual model was developed on the basis of four integrated approaches to identify the four dimensions: the political, the legal, technological and social dimensions [6]. This model is further extended to three nested levels of analysis: the national context, which also includes technological as the macro-level, socioeconomic, and political environment. A virtual political system establishes the opportunities to mediate between the citizens and state through the use of digital information and communication technologies by civic society and government. This enables a political process to take place. The individual participation within the virtual political environment is determined by the individual or micro-level of resources and motivation. This in turn leads the political system available in the digital world provide the systematic context to motivate every individual to participate online [5].

The final contextual model by Krimmer and Schuster [5] consists of the two levels: National level (Macro) and the application level (Micro). The national level, in general handles the E-Democracy where E-Voting is also examined on the level of E-Democracy. There are four dimensions in the national level that are considered in E-Democracy. The model focuses on all relevant contexts such as; national context, individual level, political context, and legal context presented in Figure 2. The model is suitable to differentiate between a project and public or national level to prevent any pilot experiences to be mistaken for national experiences. Further, the information society context is divided in national context and individual level. The national context is divided in technological and diffusion, which includes items like internet and computer penetration to be measured. The political context strongly depends on democracy, which measures sub-dimensions like institutional stability and stateness. Finally, the legal context is used to measure the democratic practices such as election system and basic protocols for human rights that lies within the context of a democracy. The aforementioned dimensions critical to E-Democracy are crucial to E-Voting as well. For each dimension, numerous indicators have been calculated and grouped together as sub-dimensions. E-Voting readiness index is then calculated based on the weighted dimensions.

Table III-A shows the E-Democracy table used by Krimmer and Schuster [5] for every dimension and sub-dimensions.

Table III-A: The Factors for the E-Voting Readiness Scale [5]
In parallel to the contextual model, the following methodology was adapted for the analysis purposes. The methodology was based on the value benefit analysis. Each dimension is divided into matching sub-dimensions and every sub-dimension contains a weighted indicator. Each indicator is evaluated on a four-level scale with 1 as the least favorable indicator gets a score of 0.25 and 4 as highly favorable indicator gets a score of 1. Subsequently, every sub-dimension is the weighted for different dimensions since the individual indicators do not possess the same importance for the evaluation of sub-dimensions. Finally, every dimension is then weighted based on the level of its importance or contribution to the E-Voting readiness. The final sum of the weighted dimensions results in the E-Voting readiness result.

In the study by Krimmer and Schuster, [5] the methodology that was used is the combination of the contextual model and value benefit analysis. For this purpose, some additional factors were developed for each sub-dimension. As a result, 79 single factors were identified: Political context: 16, legal context: 10, information society context: 29, and E-Voting: 24 [5]. Then the sub-dimensions and the factors were weighted, where E-Voting was weighted with 40 percent and the remaining three macro levels with 20 percent each. This methodology was performed across all the European Union states and countries with E-Voting experience with data availability, these countries in addition to European states were: Switzerland, Russia, United States and Venezuela. The study by [5] resulted in the following weighted factors as per the four dimensions. Table III-A is the result.

The research was extended by a team of IT experts and used desktop research to collect data and assessed the factors between 0.25 to 1. Every specific item was evaluated by consulting research articles, press releases, experts and different other sources in the World Wide Web [5]. From the results, the United Kingdom shows highest suitable environment for E-Voting. That is because of the well-developed political context with the indicators: constitutional state, democratic institution stability, political participation and political aims scoring the highest. The legal context of United Kingdom is also well developed i.e. no restriction in the electoral system is present. Finally, the IS context, a few restrictions were found: The voting register is organized de-central and electronically and no citizen registration is implemented [5]. Beyond that, United Kingdom has successfully tested all kinds of electronic voting and thus scoring the highest in the E-Voting category among the four dimensions presented in Table III-B.

### B. Experience of Estonia and Netherlands in E-Voting

Estonia has successfully been the first country to have introduced Internet Voting (I-Voting) and with obtaining legitimate results. During the elections in 2005 and 2007 Estonia used Internet ballot for national level election. The number of Internet voters in the 2007 were three times higher compared to 2005. The use of I-Voting and E-Voting (which was also introduced twice as additional channel to the Estonian voters) has been politically and technologically successful. All the technologies used in the I-Voting had no security or functionality issues, on the other hand, the election process was carried under democratic law, making it politically correct. The result of I-Voting in 2005 and 2007 statistic is shown in Table III-C. [3, p. 23].

The statics in Table III-C shows that there was a great turnaround in the 2007 election use of I-Voting. The transparency in trust on the system was carried out through testing the system before the actual voting began in 2007. 4,000 voters tested the system in 2007 elections to ensure that the system was capable of trust [7].

The legitimate and transparent election results in Estonia are based on three levels: political/legal legitimacy, voter transparency, and system transparency [7]. Transparency in the election is ensured to avoid individuals or voters engage in any fraud or any other sort of acts that would disrupt the election process. Legitimacy can be evaluated as quoted in the report by Maaten and Hall [7] “In evaluating
legitimacy, there are key features to examine based on international principles. In order to evaluate the Estonian electoral system with Internet voting, it is important to determine whether the system has legal legitimacy among the public, the government, third-party election monitors, and the electoral administrators that implement elections. It is also important that there are procedures in place that facilitate election observation and electoral transparency.

The fact that Estonia has been successful in using I-Voting is due to the strong political will and legal framework that supports the overall I-Voting process.

On the contrary, based on the case study by Leontine Loeber [8] on the use of E-Voting in Netherlands shows that E-Voting is no longer supported in Netherlands after a fraud election in 2006. Before that, almost 99 percent of the voters in Netherlands cast their votes using voting machines. The Dutch legislation on election accepted both paper ballots voting through voting machines. During the municipal election of 2006, one of the candidates obtained 181 votes in one polling station while obtaining only a few votes from the rest of the polling stations. This was a surprise and lead to an investigation. The voting machines used in the election were rented from Nedap[2], the Nedap machines did not have paper trails, where a manual recount would be made. Therefore, a shadow election was formed to ensure the transparency. As a result, the candidate did not win this time. This in-turn, led to a serious election fraud, which even raised concerns if this fraud was committed in the earlier elections as well since the use of voting machines.

Subsequently, in 2006, a campaign was launched by an action group to obtain information concerning the use of voting machines and succeeded in buying a few of the voting machines used in the 2006 election and began to investigate them. The people in the campaign group found the defects in the voting machines after deciphering the operating system of Nedap machines and overwriting the programs that would easily commit to fraud. The program also transferred certain number of vote cast from one candidate to another. In addition, there were also problems like voter secrecy exploitation, which was not supported by the machine. These eventually, led to withdrawal of the voting machines by the cabinet. And E-Voting is no longer supported in Netherlands.

IV. MOORE’S TECHNOLOGY ADOPTION CURVE

A quantitative way of exploring technology adoption life cycle is through the sociological model of Moore’s Adoption Curve. This model describes the adoption or acceptance of a new product or innovation. The process of adoption over time is illustrated as a normal distribution illustrated in Figure 3. The model is used to indicate several group of adopters. The first group of adopters are known as innovators - the innovators are the more educated and risk oriented, and more prosperous group. The innovators are followed by another group called early adapters - these are also educated, includes community leaders but could be less prosperous than innovators. The next group is the early majority - these group of adopters are open to ideas but more conservative who are also active in community and have influence to neighbors in their community. Next comes the late majority and laggards. Late majority are group of older, less educated, and less socially active. The laggards are the last group of adopters who are very conservative, oldest and least educated people. [3, p. 23].

Crossing the chasm is the closely related to the technology adoption life cycle where all the aforementioned five segments are recognized. The crucial step is the transition between early adopters and the majority. If a successful firm can create a major effect in which enough momentum builds, then the product becomes a standard [9].

V. CONCLUSION

It is important to study the readiness level of a country before taking any advanced technological step. Readiness index is a key to have a general understanding of a country’s preparedness towards any kind of automation. The studies presented in this report are a good example of how readiness index is calculated and how to choose the right components.

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[2] A supplier who provided voting machine for the election in Netherlands. Nedap built voting machines with panels that were big enough to contain all the candidates for an election.


<table>
<thead>
<tr>
<th></th>
<th>Local elections 2005</th>
<th>Parliamentary elections 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of I-votes</td>
<td>9,681</td>
<td>31,064</td>
</tr>
<tr>
<td>Repeated I-votes</td>
<td>364</td>
<td>789</td>
</tr>
<tr>
<td>Number of I-voters</td>
<td>9,317</td>
<td>30,275</td>
</tr>
<tr>
<td>I-votes cancelled by paper ballot</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>I-votes counted</td>
<td>9,287</td>
<td>30,243</td>
</tr>
<tr>
<td>% of I-votes among total votes given</td>
<td>1.9%</td>
<td>5.4%</td>
</tr>
<tr>
<td>% of I-votes among total advance votes given</td>
<td>7.2%</td>
<td>17.6%</td>
</tr>
<tr>
<td>% of I-votes cast abroad (51 countries in 2007)</td>
<td>n.a</td>
<td>2%</td>
</tr>
</tbody>
</table>
a measuring tool. In addition, from the two Estonian I-Voting experiences seem to prove that remote E-Voting is made possible by solving the legal and technological obstacles. This ensures that a high level of public trust and confidentiality about the use of the system is maintained. Finally, Moore’s law of technology adoption curve is another way of exploring the acceptance of technology - the model clearly presented the several groups of adopters and can provide an insight a sociological model.

REFERENCES


