ALTERNATIVE FUTURES FOR GLOBAL DIGITAL ECOSYSTEMS

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Abstract

This paper explores the global digital ecosystems and their potential future developments. It makes three contributions. First, the concept of the global digital ecosystem is introduced instead of a digital economy. The development of digital ecosystems depends on several political and social factors in addition to economic and technological drivers. Particularly, the role of governance and institutions is emphasized for structuring global digital ecosystems. Second, the future of global digital ecosystems is explored based on scenario planning. This approach allows us to consider alternative future trajectories rather than rely on the extrapolation of current trends. Last but not least, the paper discusses different scenarios developed by international and national organizations that highlight potential futures for global digital ecosystems. The difference and similarities in these scenarios are summarized and implications for Estonia are highlighted.

Introduction

The digital ecosystems are increasingly structuring our economic, political, and social life. The number of people using the internet has increased to 4.1 billion globally from 1.8 billion ten years ago. Digitalization has re-organized many economic sectors such as shopping and entertainment and has wide-reaching macroeconomic impacts as well as the ability to challenge the essence of democratic politics.

15 years ago "internet", "online" and "virtual" were separate from "real life" but this distinction has increasingly blurred with the introduction of the smartphone in 2007. Digital tools have become so embedded in our daily life that it is difficult to go on with daily activities or even imagine life without them. This is so particularly in the case of large digital platforms such as Google, Amazon, Facebook, Apple, and Microsoft which is sometimes referred to as GAFAM. But it is also true for some government-run platforms such as the Estonian X-Road which as the backbone of digital infrastructure facilitates data sharing among public-private platforms (PPP).

This paper will explore alternative futures for global digital ecosystems. It will consider how economic, political, and social developments will shape them as well as how these constantly evolving ecosystems shape the socio-economic context. It will do so by relying on scenario planning instead of singular forecasting and prediction. This approach allows mapping out alternative scenarios

based on work carried out by foresight teams at international and national organizations.

Since the future is uncertain, particularly in the long-term, extrapolation of current trends to the future has serious limitations and risks. Even our understanding of past developments and current trends concerning digital platforms and socio-economic consequences depends on one's perspective. Therefore, positive theorizing based on ideal types allows engaging in thought experiments about alternative futures for specific digital ecosystems.

The paper starts by discussing the nature of digital ecosystems and how they interact with governance as well as with broader political, economic, and social contexts. This is followed by emphasizing the importance of the scenario planning approach in understanding potential future trajectories. Then it discusses the different scenarios for global digital ecosystems by highlighting common denominators and differences. The paper concludes by highlighting implications for Estonia.

Digital Ecosystems: Trends and Perspectives

The Internet emerged as a decentralized network with clear advantages over centralized and smart digital networks in the 1990s. As Isenberg wrote in his article "The Dawn of Stupid Network" in 1998: "Stupid Networks have three basic advantages over Intelligent Networks – abundant infrastructure; underspecification; and a

universal way of dealing with underlying network details, thanks to IP (Internet Protocol), which was designed as an "internetworking" protocol" (Isenberg 1998).

However, these trends in the development of the Internet did last for long and gradually the Internet started to become smarter. Platformization became a new trend and turned different segments of global decentralized Internet into "gated communities". The user experience of China's government-controlled internet is radically different from the user experience of American private platform-dominated internet. Even though it must be admitted that the use of data in China is diverse and the central government often lacks the ability and capacity to control data effectively (Yang et al 2020).

In China, though limited by government-imposed rules, algorithmic decision-making and "personalization" allow the provision of individualized user experiences. To illustrate, Facebook feeds to each user differ radically depending on their preferences and characteristics. Hence, in this sense, there is no such thing as the Internet providing a single experience, but rather different internets providing individually customized experiences. Therefore, these websites provide individualized user experiences but the process is managed by highly centralized platforms with a global reach.

Digital platforms

Digital platforms have been around in one form or another since the mid-1980s with the introduction of the Windows operating system or, even earlier, as software operating systems were opened. Engineering literature on platforms dates back to the 1980s, but this usually referred to the ability to put different "skins" on underlying standardized chassis, as, for example, is the case in automobiles. Economics and management scholars started to investigate the platform dynamics in the late 1990s and the 2000s (Cusumano and Yoffie 1999; Gawer and Cusumano 2002; Parker and van Alstyne 2005). Scholars have explored various fundamental aspects of platforms such as lock-ins (Arthur 1989), network effects (Katz and Shapiro 1994; Parker and van Alstyne (2005), winner take all nature (Noe and Parker 2005), two-sided markets (Rochet and Tirole 2003), and multisided platform markets (Evans 2003) as well as long-tail markets (Brynjolfsson et al 2006).

However, the importance of digital platforms increased. This has led also to an additional emphasis in the academic literature on the culture connectivity (Van Dijk 2013), boundary resources (Ghazawneh and Henfridsson 2013), and, most importantly, on ecosystems (Jacobides et al 2018). Digital platforms are not just facilitators in business transactions but increasingly both participants, gate-keepers, and rule-makers in two- or multi-sided markets. This exploitation of information asymmetries and reliance on conflicts of interests creates

opportunities for abuse, which may not only undermine specific market-places but trust in capitalism and democratic governance.

Economists increasingly talk about the "Amazon effect" where the rumor or belief that a key platform, such as Amazon, enters or is rumored to be entering a market so stock prices of the incumbent firms immediately drop. It has even been suggested that the decisions of a large platform firm can impact macroeconomic indicators such as wage growth and inflation (Krishna 2019).

Digital platforms are changing the nature of work by substituting different functions of jobs and creating new opportunities for underemployed and underused assets. They impact entrepreneurs by making it easy for smaller players to reach global markets but at the same time also develop power over those using the platform commercially to the point where it has been suggested that there is an "emergence of a new and enormous category of businesses operated by platform-dependent entrepreneurs" (Cutolo & Kenney 2019).

This is particularly so with platforms that have dominant market power globally and can be seen as "systemically important digital platforms" (SIDP). In many ways, they are similar to systemically important banks in that they provide an economic critical infrastructure (Kitsing 2018). In doing so, they are providing essentially semi-public goods and with explicit or implicit public sector backing have become "too big to fail" (Iversen & Soskice 2019, 210).

This is the key distinction between dominant platforms such as GAFA and other platforms such as Spotify or Booking.com. In many markets, substitutes are not easily available for GAFA-like platforms, which often enjoy a monopoly position (Kenney and Zysman 2020). Their demise would affect enormous numbers of businesses and economies while the demise of systemically unimportant platforms would lead to the emergence of new substitutes or consolidation.

Digital ecosystems

Even though many different concepts are used to describe this phenomenon such as sharing economy, GAFAnomics, precariat, and so on, the most encompassing is the "platform economy" (Kenney & Zysman 2016; Iversen & Soskice 2019, 142). However, the platform economy itself is limited-term because this power is not only about the economy but also about politics, culture, and social issues in the broadest sense.

Hence, it makes sense to talk about the rise of new global digital ecosystems with far-reaching economic, political, cultural, and social consequences (Jacobides et al 2018). The use of ecosystems instead of the economy allows avoiding economic determinism where "economy" determines developments in other areas.

The economy does not operate in a vacuum but it is interdependent with politics, culture, and society (Iversen & Soskice 2019). There is a rigorous debate in the comparative political economy literature on

how this interaction is structured. However, it does not have to be elaborated here. Most importantly, the economy cannot be decoupled of politics, culture, and social issues.

Often, these ecosystems are dominated by private platforms that they have a direct impact on and politics have an impact on platform businesses. The Facebook business model came under scrutiny in the 2016 United States presidential elections because of the alleged manipulation of this platform by the Russian troll farms. Countries have different regulatory approaches to platform business models. Some countries are very open and facilitative. Some countries try to ban, regulate, or even design specific tax policies vis-à-vis platforms. Some countries try to navigate on a balanced course by welcoming some platforms but banning others. For instance, Denmark allows Airbnb to operate but not Uber and other ride-sharing companies. China, of course, basically bans foreign platforms.

Global competition

The interaction of economics and politics with digital ecosystems is most visible and consequential in so-called technology wars between the United States and China. The US multinationals such as Google were first to exploit the potential of digitalization on a global scale.

Gradually, Chinese platform business groups (PBG) such as Tencent, Baidu, and Alibaba emerged which led to stand-offs in the Chinese and other markets. Google left China. However, Chinese groups have

not limited their expansion to the domestic market but have achieved some global presence through investments in other platforms.

The interaction between the US and China can be illustrated through a stylized sequential prisoner's dilemma game. In this game, the US platform moves first and acquires global market share. Let's assume that because of network effects it is likely that one platform will dominate this global market and it can acquire all profits which are marked with 100 in Figure 1.

In this game, it does not make sense for a competing platform from China to enter the market as it would make an immediate loss of 5. Hence, the equilibrium is (0, 100). However, China introduces a subsidy (+10), which immediately creates incentives for the Chinese group to enter. "Subsidy" is used loosely as it can be monetary support, rule-making, or anything else supporting the Chinese platform's global ambitions.

As a result of this support, a new equilibrium emerges (0, 110). It assumes that the US tech company will leave the market as it is not possible to make a profit. This is the case with the Chinese market but does not necessarily work globally. Rather a tit-for-tat retaliation will follow where the US government will start using different policy tools to support its tech platform directly and indirectly. Obviously, real-world interactions are more complex, but this stylized illustration allows us to capture the tit-for-tat nature of the global digital platform competition.

Figure 1. Global interactions between Chinese and US tech platforms.
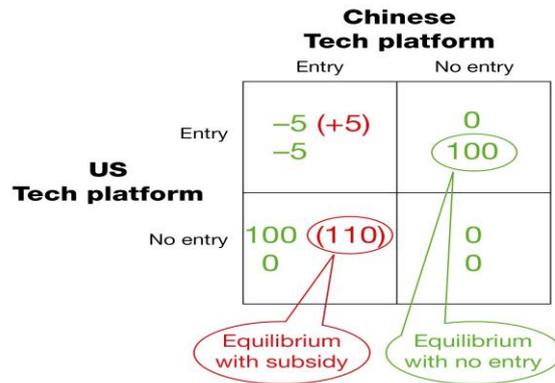
Source: the Author

The competition in search between Google and Baidu as well as Huawei and Western 5G network providers can be characterized by this game. The stand-off between China and the US has secured some degree of competition in the oligopolistic technology market. Without these tensions, the potential for cooperation and market concentration would be greater. To illustrate the competition in global technology markets, we can use a simultaneous Cournot game. In this game illustrated by Figure 2, competition between Chinese and US tech platforms results in lower profits for each in the range of 100-399; while cooperation will result in an equilibrium of 400-404 for each depending on their preferences. This hypothetical market is described

in the Appendix. The key point is that securing competition in the oligopolistic makes tech platforms less profitable, but it benefits the users of these platforms.

Figure 2. Cournot competition between technology platforms.

	Chinese Tech platform	
	Cooperation	Competition
US Tech platform — Cooperation	400–404, 400–404	100−, 404+
US Tech platform — Competition	404+, 100−	100–399, 100–399

Source: the Author

Global governance

The global governance of digital ecosystems has been characterized by a diverse set of actors and a combination of self-regulation, co-regulation, and top-down regulation. Internet governance organizations such as Internet Consortium for Assigned Names and Numbers (ICANN) are loose networks of industry players as well as US government departments. China and other authoritarian governments have tried for decades to bring these issues under the UN body called the International Telecommunications Union (ITU).

The latest attempt is to replace the current decentralized Internet Protocol (IP) with the centralized "New IP" developed by the Chinese government and Huawei (Murgia & Gross 2020). The top-down architecture supposedly secures better efficiency and capacity to facilitate the internet of things and other development. The initiative is backed by Russia, Saudi Arabia, and other authoritarian governments, but it is opposed by most Western governments.

However, digital ecosystems are governed by a vast variety of rules. Some rules are made by international bodies, such as the ITU or ICANN. Yet, regional organizations, such as the EU, also implement laws such as competition policy. Lastly, some issues are left to be handled by the national governments. Most importantly, digital ecosystems are also subject to nearly untrammeled rule-making by private digital platforms as has been emphasized above.

The complexity and competing visions concerning global rulemaking is a crucial factor in understanding why digital ecosystems face an uncertain future – particularly in the long run. It is not clear at all what governance models for ecosystems will dominate in the future or whether there will be a universal single model or model diversity.

Following literature in comparative political economies, it is likely that different approaches will emerge as a result of the interaction of politics, economics, and social issues. Hence, the governance and institutional frameworks are fundamental for structuring digital ecosystems. These ecosystems are not technologically pre-determined.

As Acemoglu and Robinson (2019) emphasize, some countries may find a proper balance between the leviathan of top-down state control and bottom-up societal approach while the latter or former will dominate the ecosystem in other countries.

Radical regulatory approaches may emerge in some countries to split up systemically important digital platforms. Others may prefer to build government-run platform ecosystems. Finally, some countries may start to substitute public sector functions with private digital platforms. These uncertainties will be explored in this paper by the scenario planning approach but, most importantly, the future of platforms is shaped by political, economic, and social developments.

There is a tradeoff between efficiency and equity concerning digital platforms. Some governments have focused more on the efficiency of digital service delivery facilitated by platforms; meanwhile, others are more concerned about citizens' rights, security, and protection of interest groups whose livelihoods are affected by platform business.

Nevertheless, the co-creation of public goods by private and public players may reduce these tensions. Obviously, it depends on what kind of digital platforms will become dominant. Large centralized platforms are likely to be more efficiency-driven while decentralized platforms may be capable of both enhancing efficiency and equity. Top-down private, public, and semi-public platforms focus on

uniformity while more decentralized platforms take advantage of diversity. Both approaches have pros and cons.

Most importantly, governance is fundamental to structuring the digital ecosystem. Digital governance experts and scholars have increasingly started to discuss the digital government as a platform and emphasized the importance of platform-based governance (Linders 2012; Janssen & Estevez 2013). For instance, Estonia launched its digital governance platform X-Road in 2001 and it has been also exported to other countries ranging from Finland to Azerbaijan. The benefits of co-production and co-creation, open government data (OGD) can be facilitated by governance and collaboration in platform ecosystems. Elinor Ostrom, Nobel Prize winner in economics, already discussed the co-production of public services based on policing in Los Angeles already in 1972. It was based on a simple observation that citizens' cooperation created more value for law enforcement services (Ostrom 1972). Hence, the value of a public service was influenced by the interaction between the user and the provider not only by the provider. In a way, Ostrom's contributions in 1972 as well as in 1990 correspond well with network-based governance which is essential for the governance of cooperative digital platform ecosystems (Ostrom 1972 & 1990). The emerging literature on government platforms seems to be suggesting a trend towards more network-based governance rather than the use of traditional hierarchy-based approaches.

Indeed, Ostrom's contributions have gained new relevance as scholars demonstrate how the use of digital technologies and open government data enables the co-production of new public services. The government can make data and digital information available to citizens, businesses, and other actors through platforms, and as a result of bottom-up processes, new services can be created. The widespread cooperation in governance is considered also crucial in the European Union as it can lead to the so-called invisible government, where the distinction between public and private services becomes blurred. The European Commission emphasized in 2013 that public sector services can be delivered in the context of existing workflow and pattern which can considerably reduce transaction costs in their use (European Commission 2013).

As co-creation of public and semi-public goods is highly participatory, then information technology can be used to engage and facilitate citizens and businesses to influence the government in their policy-formation and decision-making processes. Furthermore, the governance of platform ecosystems need not necessarily be conducted exclusively by governments.

Private firms, associations of firms, nongovernmental organizations (NGOs), and associations of NGOs all engage in it, often in association with governmental bodies, to create governance of platform ecosystems; sometimes without governmental authority.

Some have even wondered whether "technology platforms might be the new Westphalian states" (Foroohar 2019).

These are all plausible and possible approaches but, most importantly, no concrete pattern or trend emerges particularly in the long run. Different scenarios for the governance of digital ecosystems can be constructed based on these insights.

Social consequences

The governance dilemmas are made more difficult by a diverse understanding of the social consequences of digitalization. Even though some scholars emphasize certain trends, their nature and understanding are open to challenges.

Iversen and Soskice (2019) describe "the great technology debate" as two dimensional which is illustrated in Figure 3. First, scholars can be divided into technology optimists and technology pessimists. Second, they can be divided as socio-pessimists and socio-optimists (Iversen and Sockice 2009, 260-261). Some scholars such as Frey and Osborne (2017) are technology optimists but socio-pessimists. Others, such as Gordon (2016), are techno-pessimists but socio-optimists. Some. such as Piketty (2014), are both technology and socio-pessimists; meanwhile, Brynjolfsson and McAfee (2012) are both technology and socio-optimists.

Figure 3. The great technology debate on consequences.
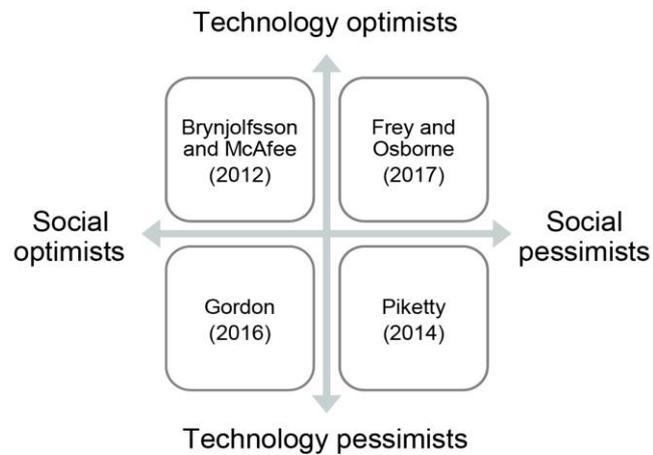
Source: the Author

At least four different perspectives emerge about technology and its social consequences on the basis of this two-dimensional approach. These alternative views of technology and its social consequences can be transferred to the exploration of the future of digital ecosystems. Various alternative futures for digital ecosystems can be created instead of relying on one vision and one linear logic.

Scenario Planning

Often we assume that we can project the future by extrapolation of trends shaping digital ecosystems. On the basis of past developments, it would be possible to map out future developments. The future is just another present. However, understanding the past and present and

visioning the future depends on a particular perspective and interpretation of real-world developments.

This is fundamentally important because the future is uncertain -- particularly in the long term. Instead of emphasizing one prediction or forecast on the basis of previous developments and current trends, it would be wise to think about it in terms of alternative scenarios. These alternative scenarios allow us to break linear logic and by asking "what…if" questions expand the range of future alternatives. This approach is known as scenario planning (Ramirez and Wilkinson 2016; Schwartz 1991).

While uncertainty about future "concerns the degree of available knowledge about the target variable, whether simple or complex", then complexity is about "the number of variables and the extent to which they are interrelated" (Schoemaker 2004, 274-275). Unknown complexity may come across as uncertainty because it is "unknown unknown". However, Schoemaker (2004) argues that complexity and uncertainty are distinct concepts.

Most importantly, the concepts of uncertainty and complexity allow us to think about the future on the basis of the two-dimensional approach. The first dimension is high complexity vs low complexity. The second dimension is high uncertainty vs low uncertainty. Scenario planning is particularly relevant for exploring future developments characterized by high complexity and high uncertainty while more

linear approaches are relevant for issues with low complexity and low uncertainty.

The future of digital ecosystems is certainly characterized by high complexity and high uncertainty. Our available knowledge about different factors impacting the future is limited. At the same time, variables to be considered are large. We have to tackle many different issue areas that are uncertain and complex in the next 10-15 years. What will be the technology developments? What will be regulatory approaches by different countries? What kind of political and economic developments will take place? How will the global economic and political system evolve? These are some questions that no one can provide certain and simplistic answers which could be taken seriously.

Hence, many foresight teams have created alternative scenarios which among other developments tackle the potential futures of digital platforms. The next section will discuss the scenarios of various international and national organizations.

Alternative Scenarios for Digital Platform Ecosystems

A significant number of foresight teams at the international and national organizations have developed alternative scenarios which, in one way or another, tackle the future of digital platform ecosystems. We will discuss recent scenarios developed by the Organisation for Economic Cooperation and Development (OECD) on digital

transformation, government scenarios of Joint Research Centre of European Commission, BSR, Copenhagen Institute for Future Studies (CIFS), Business Finland (BF), Nordic West Office (NOW) and Institute of Policy Studies at National University of Singapore (IPS), future of work scenarios by the World Economic Forum (WEF) as well as future of work and governance scenarios of the Foresight Centre (FC) at the Estonian Parliament.

All these scenarios are sufficiently generic and can be applied in a different economic, political, and social context. Global scenarios paint a more general picture of development while national scenarios help to realise how they would play out in the domestic context. In this sense, both approaches complement each other.

However, as scenarios are ideal types, then some of them seem certainly more utopian than others in a specific context. Our current understanding may indicate that some of these scenarios are more or less likely depending on the specific economic, social, and political contexts.

However, these scenarios enable us to escape linear logic in thinking about the future, so they widen the view of potential futures of platform ecosystems. We will start by discussing general global scenarios which are followed by an outline of national scenarios and then specifically we consider both global and national future of work scenarios.

Global scenarios

The OECD digital transformation scenarios address the future of digital platform ecosystems most directly (OECD 2018). Their scenario "Corporate Connectors" is probably one of the most realistic from today's perspective as it foresees the increasing dominance of large private digital platforms. The scenario "Platform Governments" foresees increasing importance of government or government-supported platforms, which is more likely in some parts of the world than others. The scenario "iChoose" emphasizes the importance of privacy and individual rights to data control. However, the least likely scenario is "Artificial Invisible Hands" which represents radical decentralisation of governance where nobody controls the data.

Four scenarios on the future government published by the European Commission's Joint Research Centre (JRC) have placed an important emphasis on digital platforms (Vesnic & Alujevic 2019). These scenarios, to some extent, overlap with the OECD's scenarios on digital transformation that digitalisation is a fundamental factor. Their scenario "DIY Democracy" entails limited availability of public services, which is substituted by strong co-creation of services by citizens. Bottom-up digital platforms facilitate grassroots initiatives but offline engagement at a local level remains important as well.

Their scenario "Private Algocracy" is characterised by the dominance of large private digital companies where citizens' interests are derived from their data profile. The scenario "Super Collaborative

Government" combines the rise of artificial intelligence (AI) with a citizen-centric government. Citizens can engage seamlessly in decision-making through digital platforms. The scenario "Over-Regulatocracy" visions nationalisation of leading digital platforms under democratic governments. However, citizens have difficulties obtaining rights and accessing good services because of bureaucratic overreach.

Technology-centricity in the JRC scenarios is certainly a limitation as institutional constraints and enablers are not fully explored. As was emphasized in the first section of this paper, digital platform ecosystems do not operate in a vacuum since they interact with economic, political, and social contexts. These scenarios certainly stem from a technology optimistic perspective and some of them sound utopian. Even if some OECD and JRC scenarios may seem from our current perspective utopian or dystopian, we cannot dismiss them as impossible because the future remains uncertain. Obviously, utopias not only exist in scenarios but can be found everywhere (for instance, in government strategy documents) as they often serve as mental shortcuts for decision-makers.

Global non-profit organization BSR (Business for Social Responsibility) has developed scenarios until 2030 that echo some of the sentiments played out in the OECD and JRC scenarios but focus more on businesses rather than governance. The first uncertainty concerns the question of whether "the forces of centralization or

decentralization prevail". The second uncertainty poses the question: "Will we continue the current economic paradigm of endless growth and profit maximization, or will we shift toward a new paradigm that views the purpose of the economy as providing for equitable prosperity on a healthy planet?" (Park 2018).

A Tale of Two Systems is a scenario about the world split into two blocs: Chinese and the Nordic bloc. Automation has caused disruption and substituted human labor in many activities. However, the policy response has been different. In the Chinese bloc, technology is used for surveillance while in the Nordic bloc the demands for transparency prevail (Park 2018).

The scenario Move Slow and Fix Things envisions that global misinformation scandals and recession have reduced trust in government and big business. More localized economies emerge exploiting technologies. The scenario Tribalism is also about decentralization but with the notion "all business is political" which implies reliance on the old economic paradigm.

Their scenario of Total Information Awareness is most relevant for the private platform ecosystems as it assumes that highly personalize Artificial Intelligence (AI) companies become part of everyday life. "Concentrated networks of huge businesses leverage extreme data to provide affordable, effective, and seamless services. Privacy is gone and much work is automated away, but most people embrace the new reality" (Park 2018, 27).

The BSR's scenarios are general by discussing different angles for businesses. Copenhagen Institute for Future Studies (CIFS) has developed specific product development scenarios 2030 for Brüel and Kjaer Sound and Vibration Measurement A/S where the focus is also on digitalization and platformization in a global context. This is natural as multinational electronics and engineering company's complex global value chains are interdependent on developments in global digital ecosystems.

The first uncertainty concerns the rate of adoption automation technology in product development (CIFS 2017) which can be gradual or exponential. Gradual adoption implies that "advanced technologies will increasingly enable, rather than displace, human expertise in product development processes". Exponential adoption means "that advanced technologies will rapidly displace human expertise, or radically alter the role of human expertise, as product development processes are automated" (CIFS 2017, 31).

The second uncertainty is about product development ecosystems where end-to-end platforms dominate or a multitude of independent development systems prevail. The former means that "global tech companies succeed in creating integrated, centralized, end-to-end platforms that stretch across the entire product development value network. Specialized companies likely face commoditization and disruption." The latter implies that "specialized companies are able to maintain agility and competitive advantage by focusing on

decentralized, flexible digital platforms, with increased collaboration across the entire product development network" (CIFS 2017, 31).

By combining these two uncertainties, four scenarios emerge. The Gatekeepers describes the world of slow technology adoption as platforms control technology processes while human expertise is used in cooperation with machines. Different regional and industrial contexts discourage "one-size-fits-all" solutions. The scenario Take-Off is characterized by platform dominance with radical innovation and adoption of new business models where technology substitutes many human tasks.

The scenario Stay Cool is about limited disruption resulting from organizational inertia where traditional business models maintain an advantage while incrementally adjusting, adapting, and digitalizing. The Mesh envisions disruption by collaboration through unexpected ways where specialist companies radically use technologies in the world of decentralized ecosystems with agile value networks.

Business Finland (2020) has developed four global scenarios where two of them are directly relevant to digital ecosystems. Data Saves and Enslaves is a scenario of diminishing trust in international cooperation and traditional institutions. Technology substitutes labour and traditional currencies. The scenario Digital Patrons in a New Era emphasizes responsible capitalism where large corporations assume an increasingly important role in global decision-making, including energy transformation and climate change policies.

The main issue with the latter scenario is the same as in the case of Cyberworld developed by the Nordic West Office (2018). The scenario Cyberworld promises that private tech companies offer global leadership and have found solutions for many pressing problems, including climate change. However, weak global institutions may imply that private sector giants may not be able to sustain their business models and collaboration. New decentralized technologies and the public backlash may lead to the Data Saves and Enslaves world.

National scenarios

At the Foresight Centre we created five public sector governance scenarios for Estonia which also paint different pictures of the role of digital platform ecosystems (Arenguseire Keskus 2018a). The scenario "Ad Hoc Governance" sees rapid digitalization in some areas as a priority while other areas are left behind because of government budget constraints. This implies that digital platform ecosystems suffer from inconsistent developments. The government sees the development of public platforms in some areas as a priority while primarily the role is delegated to private platforms. However, government priorities in platform development are constantly shifting. This implies that private platforms with consistency will win out in most areas.

The scenario "Night-watchman State" is concerned about privacy and security concerns of excessive government digitalization while trying to use a standardized approach for efficiency gains. This scenario is favorable for the development of private platforms. The government is eager to outsource the delivery of semi-public as well as some public goods to private platforms. Large global platforms from China and the United States will become increasingly important players by not only providing traditional digital services but also offering substitutes for government services at times.

The scenario "Entrepreneurial State" is about building up a highly digitalized state for entrepreneurial purposes and enhancing digital government platforms globally by relying heavily on public-private collaboration. The government has global ambitions and Estonian platforms such as e-Residency will get an additional boost and financial support. Estonian government platforms will compete directly with private platforms and other government platforms in the global arena.

The scenario "Caretaker State" is about the massive use of digital technologies in preventing the spread of social ills and intervention for the benefit of citizens' well-being. The government does not have global ambitions and aims to develop sophisticated platforms for serving citizens domestically. At the same time, the government is reluctant to collaborate with the private sector because of security concerns.

The scenario "Networked Governance" pictures decentralized public sector governance with a high degree of co-creation and use of digital platforms by different actors. As a result, platform ecosystems are diverse and uneven where governmental, business, civil society, and local community platforms operate. This scenario is similar to open-source software development processes where very diverse teams contribute to the creation of semi-public goods through different platforms. Delivery of platform services may not be always user friendly but engagement and participation of various actors are high.

These five Estonian governance scenarios have many common elements with three scenarios developed for Singapore by the Institute for Policy Studies (IPS) at the National University of Singapore. Even though these scenarios do not specifically discuss digital platforms, it is possible to derive implications for digital platform ecosystems. Their scenarios "SingaStore.com" emphasizes the importance of economic development and private businesses at the expense of social cohesion. It would imply the dominance of private platforms as in the Estonian scenario "Night-watchman State" – even though Singaporean scenarios see a somewhat more important role for government (Institute for Policy Studies 2012). The scenario "SingaCity.gov" emphasizes the role of government in promoting egalitarian social values and human development (like Estonian scenarios "Caretaker State). This implies the development of dominant government platforms which structure the ecosystem. The

scenario "WikiCity.org" is essentially a decentralized governance scenario where no central authority dominates – it is a self-activating and self-correcting community (like Estonian scenario "Networked Governance"). This implies a diverse and pluralist platform ecosystem with many different players from businesses and communities.

It is worthwhile to look at two sets of future of work scenarios, which elaborate on the issues of digital platform ecosystems from the perspectives of global work platforms. World Economic Forum's (WEF) eight scenarios on the future of work offer a take on the interaction of technological change, the learning evolution, and the talent mobility in the context of long-term employment patterns in the world (World Economic Forum 2018). We analyse the scenarios from the prism of the adaptation with the technological change, which can be either steady or accelerated.

The scenarios where technological change and diffusion accelerate significantly are the ones where skills and mobility determine whether opportunities posed by technological development are captured. However, these scenarios also entail the risk of increasing polarization. "Robot Replacement" is a world with low talent mobility and slow learning evolution. The outcome is the hollowing out of the labour markets. This results in protective governments, tight border control, and a looming threat of social disruptions. In a "Polarized World" the learning evolution is still low but there is a high level of talent mobility. As a result, the highly skilled emigrate from regions

with slow development and enclaves of global super-economies form. Both scenarios suggest development trajectories toward government platforms.

In a scenario called "Productive Locals," the adjustment to fast technological development has been matched with life-long learning and vast retraining programmes. Talent mobility, however, is low to make sure that investment in human capital makes sense regionally. Online labour markets on digital platforms make up for talent shortage in some regions but this is not sufficient to ensure the skills spillover and the spread of innovative ideas. "Agile Adapters" combines accelerated technological change with fast learning evolution yielding a hyper-agile world where people combine physical and virtual mobility. There is widespread use of private online digital platforms for work.

In the worlds with steady technological change and diffusion, the growth potential is smaller but is mostly more inclusive towards a larger group of people. "Workforce Autarkies" combine steady technological change with low learning evolution and low mobility results in losing the competitiveness of local labour markets due to talent shortage. In "Mass Movement" the learning evolution is slow and regions mostly experience slow growth encouraging their talent to look for alternative options. The online work platforms are a marginal phenomenon in the scenario resulting in high migration flows of talent to where the highest growth and most innovative solutions are offered.

"Empowered Entrepreneurs" is a world where amid slow adoption of technology the investment in human capital has been high and thus governments are limiting mobility not to lose their talent. Workers are empowered to create opportunities for themselves and often become entrepreneurs by selling their services globally using online platforms. Both learning evolution and mobility are high in the scenario of "Skilled Flows". Online platform work is still a marginal phenomenon in the scenario. This results in high inequality between countries and regions as some have better access to technology and thus migrating talent than others.

These four future of work scenarios were developed by the Foresight Centre (Arenguseire Keskus 2018b). The scenarios envision the impact of technological change and attitudes towards mobility as the main shapers of Estonian employment market outcomes in the future.

Two of the future of work scenarios describe worlds where technological development enables the creation of highly skilled jobs which offsets the effect of automation in low-to-mid skill tasks and offers potential for long term economic growth. In the case of scenario "Talent Hub Tallinn," the potential is realized thanks to having access to a global pool of talent who have the right skills to employ technology. Online digital platforms are seen here as an additional way of matching supply and demand on a global level and enabling agility in a fast-changing world. This is supported by blurring the line between employment and entrepreneurship – an increasing number of

workers are own-account workers providing their services on a global level.

In "Self – Reliant Estonia," the potential of technological development could not be used to its full extent as mobility is restricted and there is a lack of highly skilled people to innovate and use technology. Online labor platforms can offer some alleviation here for the companies suffering from talent-shortage but may become a subject of restrictions to protect the local labor market. An emergence of government or regional work platforms would be likely in such a world to ensure that the local labor market is not threatened by virtual outsiders.

In worlds where automation effects prevail and fewer new jobs are created, the outcomes of high and low mobility scenarios differ vastly when considering the platform ecosystem effects. In case of high mobility, the automation is initially postponed but eventually inevitable, as happens in the "Global Village of Nomads". The role of digital platforms for finding work is a minor one as it does not offer sufficient livelihood opportunities for low-skilled people and they prefer migrating instead. When the migration is restricted, as in the scenario "New World of Work," the online global work could be a substitute income to people who cannot find work in the local labor market. Given the increasing level of unemployment and protective attitudes, a restrictive approach towards private digital platforms is

likely. Governments may create platform cooperatives or other alternative models to tackle this threat.

Meta-scenarios

Even though scenarios were developed for the diverse global and national context, they do offer some universally applicable trade-offs concerning the future of digital ecosystems as we have shown in the case of more limited comparison (Kitsing & Vallistu 2020). On the basis of national scenarios and scenarios developed by international organizations, three meta-scenarios for the future of digital ecosystems emerge. Particularly as BRS, NWO, BF, Estonian and Singaporean scenarios also overlap with the OECD, CIFS, and JRC scenarios to some extent – even though most of them are less technology-centric and emphasise institutional factors as key drivers.

In the WEF and Estonian future of work scenarios, digital ecosystems play an important role in some but not in others. Since WEF created eight scenarios, then only four scenarios with accelerated technological change and significant role for digital platforms are included in the comparison. Four scenarios with a marginal role for digital platform ecosystems are excluded.

As far as governance scenarios are concerned then the Estonian scenario "Entrepreneurial State" and Singaporean "SingaGives.gov" has common characteristics with OECD's "Platform Governments", CIFS' Gatekeepers and BSR's "A Tale of Two Systems". The JRC's

scenario "Over-Regulatocracy" has many elements in common with the Estonian scenario "Caretaker State".

The dominance of private digital platforms as envisioned in the OECD's "Corporate Connectors", BSR's "Total Information Awareness", CIFS's "Take-Off", NWO's "Cyberworld" and in the JRC's "Private Algocracy" is most likely in the Estonian scenario "Night-watchman State" and Singaporean "SingaStore.com". Estonian scenario "Networked Governance" and Singaporean "WikiCity.gov" have many elements in common with the JRC's "Super Collaborative Government", BSR's Tribalism, and the OECD's "Artificial Invisible Hands".

The key difference is that both OECD and JRC scenarios place much greater emphasis on digitalisation than the Estonian and Singaporean and other scenarios. It is completely understandable in the case of OECD scenarios because these are digital transformation scenarios, which also discuss some aspects of governance.

However, the JRC's scenarios are government scenarios where technology-centricity may narrow down a range of possible and plausible alternatives for digital platform ecosystems. Particularly so because institutional constraints are not likely to be broken down in 10-15 years.

In this sense, other scenarios are more general and offer a wider range of alternatives. For instance, both JRC's "DIY Democracy" and

"Super Collaborative Government" could be sub-scenarios of "Networked Governance". The latter would work under generous budget constraints while the former in the case of tight budget constraints.

The future of work scenarios offer a narrower story on the development of digital ecosystems. Some of these scenarios assume a linear development of global private platform ecosystems. The ideas of government or decentralized platform ecosystems are not straightforward in the scenarios but can be likely results of interpreting the scenarios. WEF's scenarios are a good example of how the institutional and social factors are accounted for in addition to technological development when placing digital platforms into a wider scenario context.

The Foresight Centre's future of work scenarios see online work as part of a techno – optimistic globalised world as well as a substitute for real mobility options. In the latter case, however, the shift from private global platforms could take place towards government platforms or decentralized local platforms as governments try to protect their labour markets and workers.

Most importantly, the combination of these different scenarios allows mapping out three meta-scenarios for digital platform ecosystems. The meta scenarios are the following: 1) Private platform ecosystems 2) Government platform ecosystems 3) Decentralized platform ecosystems.

Table 1 will summarize the key elements of each scenario and will indicate which scenarios from OECD, JRC, CIFS, NWO, BRS, BF, WEF, and FC correspond to this classification.

The Private Platform Ecosystem (PPE) scenario implies the dominance of large private platforms globally - particularly from China and the US. The digital ecosystems are characterized by global gated communities and "surveillance capitalism" where access depends on consumer's value. Large platforms from China and the US collaborate in artificial intelligence (AI) and other fields as regulatory capacities of states are constrained by effective rent-seeking by platforms.

There is the limited ability of governments – particularly of small countries- and public international organizations to direct platform ecosystems as private platforms are the main rule-makers. The dominance leads also to the provision of (semi-)public goods by private platforms in addition to private goods.

The scenario Government Ecosystems (GES) means the dominance of government platforms as technology wars among the US and China leads to splinternet globally. These developments imply the emergence of New IP in China and affiliated countries. Meanwhile, the old IP is used in the US and among its allies. Reduced economies of scale and network effects imply that digital ecosystems become less efficient.

The scenario leads also to the increasing dominance of larger countries over smaller in regional blocs. This may mean that transparency and openness are vital due to societal pressures in some blocs while not in others where the leviathan is in charge of data and platform ecosystems.

The Decentralized Ecosystem (DES) scenario is characterized by the diversity of platform ecosystems with multiple private, community, local, national, and global solutions. There is also a huge divergence in the regulatory approaches which looks like Swiss cheese with overlapping authorities and gaps offers opportunities for regulatory arbitrage.

Overall, the dominance of old IP is crucial in most countries as the stupid network is important for decentralized solutions. However, some authoritarian states experiment with new IP. Some states offer solutions top-down fashion while most rely on a bottom-up approach by relying on private, local, and community actors. In this scenario, different capacities and capabilities create robust benefits of decentralized innovation but also lead to inequalities and risks.

Table 1. Three meta-scenarios for digital ecosystems and their characteristics.

Meta-scenario	Characteristics	Corresponding scenarios
Private platform ecosystem	Dominance of large private platforms globally - particularly from China and US. Global gated communities where access depends on consumer's value. Collaboration among various platforms in AI and other fields. Limited ability of governments and public international organizations to direct platform ecosystems as private platforms are the main rule-makers. Provision of (semi-)public goods by private platforms.	Corporate Connectors (OECD), Private Algocracy (JRC), Total Information Awareness (BSR), Take-Off (CIFS), Digital Patrons of a New Era (BF), Cyberworld (NWO) SingaStore.com (IPS), Night-watchman State and Ad Hoc Governance (FC), Agile Adapters (WEF), Talent Hub Tallinn (FC), Global Village of Nomads (FC),
Government ecosystem	Dominance of government platforms, splinternet globally. Emergence of New IP in China and affiliated countries. The use of old IP in the US and among its allies. Reduced economies of scale and network effects. Dominance of larger countries over smaller in regional blocs. Transparency and openness in some blocs while not in others.	Platform Governments (OECD), Over-regulatocracy (JRC), A Tale of Two Systems (BSR), Gatekeepers (CIFS), Entrepreneurial state (FC), SingaGives.gov (IPS) Caretaker state (FC), Robot Replacement (WEF), Polarized World (WEF), Self–Reliant Estonia (FC)
Decentralized ecosystem	Diversity of platform ecosystems, multiple private, community, national and global solutions. Divergence in regulatory approaches. The dominance of old IP while some states experiment with new IP. Some states offer solutions top-down fashion while others rely on a bottom-up approach by relying on private and community actors. Different capacities and capabilities create benefits of decentralized innovation but also lead to inequalities and risks.	iChoose and Artifical Invisible Hands (OECD), DIY Democracy, Super Collaborative Government (JRC), Move Slow and Fix Things The (BSR), Tribalism (BSR), Mesh and Stay Cool (CIFS), Data Saves and Enslaves (BF), Productive Locals (WEF),WikiCity.sg (IPS) Networked governance (FC), New World of Work (FC)

Source: the Author

Implications for Estonia

Even though these scenarios are developed within specific business and policy frameworks, they do offer generic trade-offs for Estonia. One robust takeaway is that countries can leapfrog technological developments against all odds.

The digitalization of Estonia is the case in point. Estonia was a relatively poor country with Gross Domestic Product (GDP) per capita of 3000 US dollars in 1995. The capacity to invest in new technologies was limited. However, new start-up banks introduced internet banking in 1996 which was used by the government as a platform for offering online services such as tax declaration starting in 2000 (Kitsing 2017). Starting as 'tabula rasa' without legacy systems unlocked potential that countries with technological and institutional path-dependencies find difficult to overcome.

Nevertheless, policy-makers still have to make decisions about which direction to take. That's why we explore alternative global scenarios and their implications for Estonia because the future of platform ecosystems is primarily about institutions – the rules of the game - and less about technology. Should institutional design encourage a more laissez-faire approach and be a more market-based platform ecosystem? Should the government be more active and develop its own platforms where both private and public players can converge? In addition to these private vs public platforms, it is a question of centralization and decentralization.

The backbone of Estonian digital infrastructure – public-private platform X-Road is a relatively de-centralized platform. This allows for a greater degree of structured pluralism and bottom-up innovation. However, it also creates challenges. Several public institutions and many private – especially SMEs – are not on the X-Road. Recently, the Ministry of Social Affairs announced that they are developing a new digital service that will not be integrated with the X-Road system. Pluralism may also lead to so-called silos in service delivery.

Obviously, the role of policy-makers in the development of platform ecosystems should not be overemphasized. Policy-decisions have often unintended consequences and sometimes outcomes are a result of accidents rather than deliberate policy-design (Kitsing 2011). Most importantly, as with any ecosystem, the processes are evolutionary rather than revolutionary. The groundwork for the Estonian ecosystem was already laid in the 1990s.

Even more importantly, domestic policy-making does not take place in a vacuum but is shaped by global forces. That's why scenarios developed by OECD, WEF, CISF, BF, NOW, BSR, and EU are particularly relevant for Estonia.

How will the global platform ecosystem evolve in the next 10-15 years? The best policy responses will differ under different scenarios. Table 2 summarizes the key implications of three scenarios across different policy areas.

The world dominated by large private platforms implies that it is challenging to resist the efficiency of large global platforms in the domestic platform ecosystem. Many services will be offered by global private platforms – most likely from China and the United States - at the expense of equity and domestic stakeholder engagement. It may be efficient but not democratic. These platforms will also transfer money and power out of the country, and redistribute resources from local platforms to global platforms.

The world dominated government platforms impose risks for Estonia for losing the control of their platform ecosystem to some other government that dominates the regional bloc and splinternet. In this scenario, countries have to be particularly careful in navigating competitive terrain. However, it also offers opportunities for developing government platforms which may have regional appeal. The decentralized world seems appealing to Estonia. Many new opportunities may emerge for government, private sector, and civil society with variation and diversity. However, it also carries risks of higher transaction costs and thus lower efficiency. The key question here is whether co-creation and networked platform ecosystems will allow mitigating trade-offs between equity and efficiency or will a more equitable system operate at the expense of efficiency.

Table 2. Key implications of scenarios across policy areas.

Policy area	Private Platform Ecosystems	Government Ecosystems	Decentralized Ecosystems
General	Limited leverage, dominance of global platforms in domestic private and public ecosystems.	Binary choices about digital solutions. Dominance of EU and US in the domestic ecosystem.	Exploitation of diversity, many solutions. Risk of instability and volatility.
Cybersecurity	Global approach may provide security but does not consider domestic preferences – limited local ability to provide security.	Cybersecurity is the dominant paradigm and provides a real sense of security at the expense of other areas.	Robustness from decentralization, but unpredictability, gaps create risks.
Data	Data is privatized globally and massive use of AI and big data by global platforms.	Collection of data by governments and limited cooperation with private platforms.	Open data use by governments, businesses, communities. Privacy regulations differ.
Digital trade	Relatively open trade under tit-for-tat logic.	Protectionist, regional trade blocs.	Diverse trade regimes, high transaction costs.
Digital finance	Global payments solutions, network effects, and economies of scale	Regional payment solutions. Government regulation and surveillance.	Multiple solutions, constant competition among local, private, global.
Regulation	Self-regulation and private rule-making by global platforms.	Bloc-based regulatory alignment and tough constraints on private platforms.	Swiss cheese of overlapping regulations and conflicts.
Digital democracy	Citizens are seen as consumers in the private ecosystems – vote with their wallets.	Bloc-based approach where no democracy allowed in some while developed in others.	Key driver in many ecosystems but not in some authoritarian ecosystems.
Crisis response (pandemics, recessions), privacy and data use	Private platforms do share data governments, offer private solutions that benefit some but not many.	Governments use big data with varying efficiencies. Privacy is a concern in some but not others.	No global coordination. Divergence of local and national responses.

Source: the Author

Conclusion

In order to grasp the implications for Estonia, it is important to deepen our understanding of digital ecosystems and ways of approaching the future. We introduced the concept of the global digital ecosystem, which includes governance, political and social factors in addition to economics and technology in understanding digital platforms. We explored alternative futures for digital ecosystems based on scenario planning instead of extrapolation of current trends based on forecasting or prediction.

This approach allowed us to highlight key elements for the future developments of digital ecosystems on the basis of scenarios developed by national as well as international foresight teams. We focused particularly on digital transformation, governance, business environment, and future of work scenarios.

This allowed us to develop three meta-scenarios for the future of digital ecosystems emphasizing the importance of governance. Governance plays a fundamental role in structuring platform ecosystems.

Meta-scenario "Private Platform Ecosystems" maps out the world where large private platforms from the United States and China dominate both global and domestic platform ecosystems often replacing smaller domestic players and government platforms.

Meta-scenario "Government Ecosystems" envisions the world where governments have become dominant in directing and regulating platform ecosystems. This is a world of so-called splinternet where countries have grouped in the opposing technology blocs and domestically government platforms do not provide only public but also private goods.

Meta-scenario "Decentralized Ecoystems" is a world of diversity and pluralism where public, semi-public, community, and private platforms operate, often in collaboration. It is a world where both domestically and globally no platform has sufficient power to make or break the platform ecosystem. However, this diversity also implies uneven access to the benefits of the platform ecosystem.

These three meta-scenarios imply trade-offs for Estonia. The purpose of the scenario planning approach is not to offer concrete policy suggestions but rather to indicate potential future developments for policy-makers, which allows formulating a framework for policy responses. A robust policy suggestion is that Estonian policy-makers have to be prepared for alternative scenarios and radical changes rather than rely on one vision or strategy for thinking about the future of global digital ecosystems and implications for Estonia.

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Appendix

The following table illustrates the Cournot competition between two platforms in the global market. This is a stylized interaction based on specific assumptions. When the Chinese and US tech platforms compete by producing certain output simultaneously (without knowing each other's output choices) over 5 years, then this strategic reaction leads to profits in the range of 100-399. It assumes that players are rational profit-maximizing entities. This outcome has been confirmed many times in the classroom environment with participants ranging from high school students to CEOs of multinational firms in different countries such as Estonia, Finland, Georgia, United States, South Africa, and others. However, when two platforms cooperate by fixing output by producing only 4 units each year, then both of them receive a profit of 400 (it is also possible to earn 404 but this is more complex strategy). The bottom line is that the latter strategy is good for two platforms but not for consumers. Competition benefits consumers as it reduces profits and thus prices in the global market.

		Cournot Competition																	
		The numbers in this table give your profit for any combination of output by you and by your competitor.																	
		Output of my Competitor																	
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
My Output	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	34	32	30	28	26	24	22	20	18	16	14	12	10	8	6	4	2	0
	2	64	60	56	52	48	44	40	36	32	28	24	20	16	12	8	4	0	-4
	3	90	84	78	72	66	60	54	48	42	36	30	24	18	12	6	0	-6	-12
	4	112	104	96	88	80	72	64	56	48	40	32	24	16	8	0	-8	-16	-24
	5	130	120	110	100	90	80	70	60	50	40	30	20	10	0	-10	-20	-30	-40
	6	144	132	120	108	96	84	72	60	48	36	24	12	0	-12	-24	-36	-48	-60
	7	154	140	126	112	98	84	70	56	42	28	14	0	-14	-28	-42	-56	-70	-84
	8	160	144	128	112	96	80	64	48	32	16	0	-16	-32	-48	-64	-80	-96	-112
	9	162	144	126	108	90	72	54	36	18	0	-18	-36	-54	-72	-90	-108	-126	-144
	10	160	140	120	100	80	60	40	20	0	-20	-40	-60	-80	-100	-120	-140	-160	-180
	11	154	132	110	88	66	44	22	0	-22	-44	-66	-88	-110	-132	-154	-176	-198	-220
	12	144	120	96	72	48	24	0	-24	-48	-72	-96	-120	-144	-168	-192	-216	-240	-264
	13	130	104	78	52	26	0	-26	-52	-78	-104	-130	-156	-182	-208	-234	-260	-286	-312
	14	112	84	56	28	0	-28	-56	-84	-112	-140	-168	-196	-224	-252	-280	-308	-336	-364
	15	90	60	30	0	-30	-60	-90	-120	-150	-180	-210	-240	-270	-300	-330	-360	-390	-420
	16	64	32	0	-32	-64	-96	-128	-160	-192	-224	-256	-288	-320	-352	-384	-416	-448	-480
	17	34	0	-34	-68	-102	-136	-170	-204	-238	-272	-306	-340	-374	-408	-442	-476	-510	-544