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A Roadmap for Domiciling Tablet Industry in Developing Countries: India and Egypt

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Abstract: Developing countries are increasingly adopting in-house tablet manufacturing as a result of the cost-effectiveness and significance of tablets. This paper provides a comparative insight into the tablet manufacturing industry, focusing on Egypt and India. The pursuit of tablet manufacturing and integration within educational institutions in both countries stands as ambitious endeavors. Commonalities emerge in population size and economic challenges. Although the initiatives in Egypt and India commenced simultaneously, the Indian initiative has achieved more substantial progress. The research examines the tablet computer industry in Egypt along three technological axes: domestic manufacturing, joint production, and contracting with international manufacturing firms. The industry challenges faced by Egypt are analyzed and provide suggestions for the development of this critical sector, with a specific focus on the education industry.

Keywords: Tablet, innovation, economy, industry

1. Introduction

A tablet computer, often referred to simply as a tablet in the market, is a portable personel (PC) computing device. Its primary interface relies on a touchscreen that occupies a significant portion of its surface. Tablets typically have a size smaller than traditional computers but larger than smartphones. While tablets possess certain capabilities similar to PCs, they may lack some functionalities found in conventional computers. Tablet computers refer to the range of computers that come with a touch screen and no keyboard (Vaportzis et al., 2017). The idea of the tablet was first presented by Alan Kay of Xerox, who sketched it in 1971, but the first successful product was released in 1989 by GRiD (Grid, 2022). However, the actual market penetration of tablets began with Apple's announcement of the iPad in 2010 (Newsroom, 2010). Since then, the tablet computer market has experienced rapid growth and expansion, with various companies launching their own devices, including Samsung, Asus, and Microsoft. In 2021, the tablet computer market size was approximately $41.16 billion and was projected to reach $53.78 billion by 2029 (Dowling & Vogan, 2015).

These devices, i.e., tablet computers, change our daily life in different aspects, such as accessing the internet, performing our daily work, and shopping. However, the most effective change is the transformation of how we access and share knowledge and, thus, how people learn. Tablets have emerged as dominant tools in the e-learning sector, owing to their unique attributes—compact size, lightweight design, low power consumption, affordability in comparison to computers, and larger screen size than many other portable devices. On the other hand, tablets' limited memory space and computing power have little effect on their performance in e-learning because they are primarily used for displaying book contents, taking notes, and searching the internet. This versatility positions tablet computers as ideal candidates for replacing traditional books within the educational sphere (Chimbunde, 2023).

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Driven by the advantages of tablet computers, developing nations are keen on integrating these devices into their educational systems. For instance, the Egyptian Ministry of Education launched an initiative in 2017 titled 'Tablet for Every Student and Teacher' (Egyptian Ministry of Education, 2017). However, the high cost associated with these devices poses a significant barrier to the implementation of such initiatives. The pricing of tablet computers is predominantly influenced by two key sectors: software and hardware industries. The tablet computer hardware industry consists of several steps, beginning with the design and manufacture of tablet components such as touchscreen, rechargeable battery, motherboard, camera, and speakers. These components are then assembled to create the tablet computer, followed by rigorous testing procedures.

An effective approach to cost reduction for tablets involves localizing a portion of the manufacturing process. This can be achieved through collaborations with developed nations or by conducting technological training programs to transfer manufacturing expertise for tablets. Localizing manufacturing processes contributes to cost reduction by eliminating transportation expenses and enabling the customization of tablets tailored specifically for educational purposes. Several success stories highlight this approach, including India, renowned for producing cost-effective devices like *iSlates*, and *Aakash* (Ruyter, 2014). Additionally, another viable method involves recycling tablet computers. This approach allows developing countries to salvage valuable and functional components from older devices, repurposing them in the production of new devices.

The tablet manufacturing sector is a large industry, beginning with firms that design tablet components such as touchscreens, touchscreen frames, rechargeable batteries, motherboards, and cameras, along with their fabrication, integration, and testing. Furthermore, the tablet industry includes companies that create operating systems for tablets or applications that run on tablets. This paper compares the tablet industry in two developing countries, Egypt and India. Both countries demonstrate ambitious endeavors in integrating tablets into their educational systems and face comparable challenges related to population size and economic constraints. Despite commencing their initiatives simultaneously, the Indian initiative has achieved more significant milestones and advancements compared to Egypt.

The primary focus of this study is to offer insights into and compare the tablet industry in Egypt and India. The paper is organized as follows: Section 2 presents the background information. In Section 3, the tablet industry in Egypt is thoroughly discussed. Following that, Section 4 delves into an exploration of the tablet industry in India. Section 5 is dedicated to a comparative analysis of the tablet industries in both countries. In Section 6, we propose recommendations based on the comparative analysis. Finally, Section 7 encapsulates the paper's findings and conclusions."

2. Background

2.1 Global Tablet Market

Tablet computers find utility across a spectrum of applications, ranging from business and commerce to personal use, leisure activities, and educational purposes. In commerce, they facilitate bill payments, shopping, and various transactions. For personal use, tablets serve as surveillance tools when synchronized with monitoring devices like cameras and cater to leisure pursuits such as gaming and video streaming. Additionally, their integration into educational settings in schools and colleges has been significant. The multitude of features offered, including portability, larger high-resolution screens, and evolving user demands, collectively drive the rapid progression of tablet computer technology (maximize_market_research, tablet pc market: global industry analysis, outlook, and forecast 2022-2027, 2019). Fig. 1 illustrates the transition of tablet computer usage, initially dominated by entertainment purposes, towards increased adoption across diverse applications.

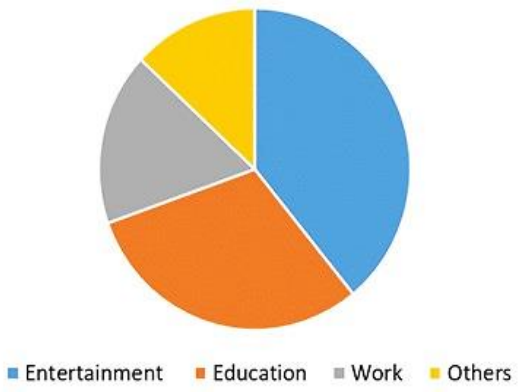

Fig. 1: Various tablet applications in the global market in 2020

Tablet computers can be categorized based on several criteria such as shape, size, features, type, manufacturer, and operating systems. Classification according to operating systems generally falls into three main categories: Android, iOS, and Windows. Android, known for its rapid expansion, holds the most extensive global distribution due to its availability

and compatibility across a wide array of devices. This is because of ease of availability and compatibility with a wide range of devices, making multiple manufacturers install Android on their Tablet computers as the operating system. That contributing to cost reduction in these devices (maximize market research, tablet pc market: Global industry analysis, outlook, and forecast 2022-2027, 2019). On the other hand, iPads operating on iOS stand as the most popular tablet computers globally. This dominance can be attributed to certain professional applications, particularly those favored by graphic designers, which are exclusively available on the iOS platform. Consequently, in 2021, the iOS sector secured the largest market share, accounting for 38.0% of the global tablet market by operating system. The global distribution of the tablet market by operating system is depicted in Fig. 2.

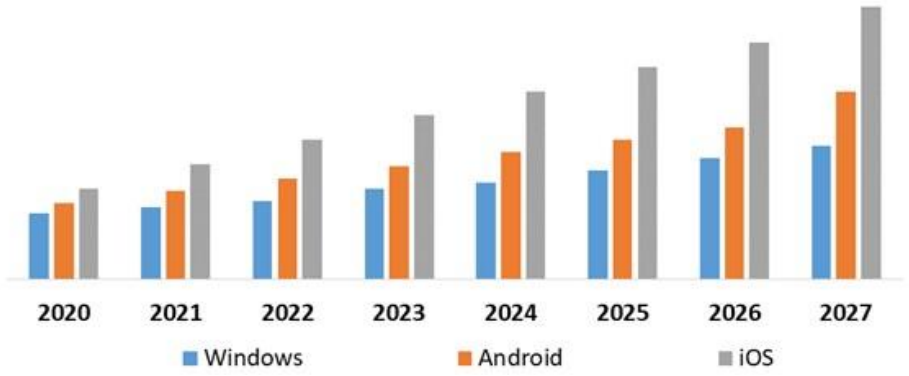

Fig. 2: Global tablet PC market, by operating system

Economically, the global tablet computer market reached $1.2 billion in 2020 and is projected to ascend to $3.5 billion by 2026, indicating a substantial 22% Compound Annual Growth Rate (CAGR) (Market Data Forecast, 2022). Fig. 3 depicts a geographical analysis of the global tablet computer market in 2021. Notably, the demand for tablet computers in North America is anticipated to surge, driven by non-traditional end-users like restaurants, education, and healthcare. In restaurant settings, tablets serve multifunctional purposes, from displaying menus to facilitating customer meal orders and enabling credit card payments. Additionally, tablets play a pivotal role in the education sector, enhancing the learning process through e-learning resources such as interactive applications and electronic books.

Numerous device manufacturers, including those in South America, prioritize regional markets. China, Japan, Asia Pacific, and developing countries such as India and Egypt are the most important anticipated regional markets. These regions are expected to wield substantial importance owing to continuous technological advancements and the projected increase in disposable incomes within these countries (Market Data Forecast, 2022; Zhang, 2022).

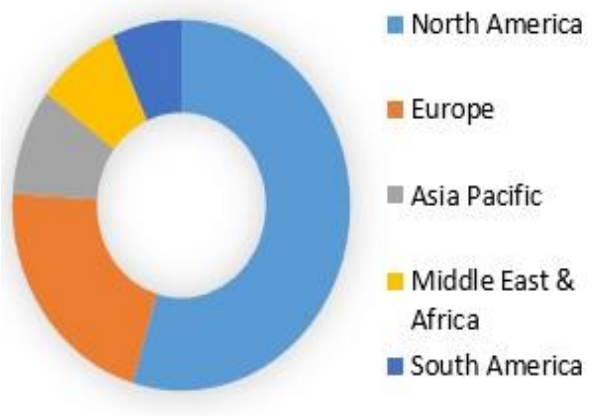

Fig. 3: Global tablet market and regional analysis in 2021

Apple, Samsung, Huawei, and Lenovo emerge as the primary leaders in the global tablet market. Table 1 shows that Apple dominates the market with its iOS operating system. While Apple demonstrates a consistent yearly increase, it is noteworthy that Android-powered manufacturers like Samsung, Huawei, and Lenovo exhibit more robust growth rates in comparison.

Table 1: Global tablet pc market, by company (maximize_market_research, tablet pc market: global industry analysis, outlook, and forecast 2022-2027, 2019)

Company	2020	2020	2019	2019	Annual
	Sales	Market share	Sales	Market share	growth
Apple	14249000	38%	11894000	40%	19.8%
Samsung	7024000	18.7%	5048000	17%	39.2%
Huawei	4770000	12.7%	3300000	11.1%	44.5%
Amazon	3164000	8.4%	2308000	7.8%	37.1%
Lenovo	2810000	7.5%	1808000	6.2%	52.9%
others	525000	14.7%	5379000	18.1%	2.7%
Total	37542000	100.0%	29767000	100.0%	26.1%

2.1.1 Technology for Education in Developing Countries

The initiative by Nicholas Negroponte in 2005, aimed at transforming education in low-income countries through $100 laptops, faced significant setbacks over the years. Despite being operational in some regions, the One Laptop per Child program is widely deemed unsuccessful. The project exceeded its budget, encountered hardware issues, and users lacked the expertise to resolve these problems, leading to minimal academic improvements. This failure has prompted a shift in focus from solely emphasizing technology to considering its integration within existing education systems. There's a notable increase in funding directed towards this approach, addressing complex matters like governance and politics within education (Edwards, 2019). Ben Piper, a regional advisor for Africa at the research institute (RTI International), highlights a fundamental shift in ed-tech. Previously seen as an attempt to bypass or replace teachers, there's now an acknowledgment of the necessity to integrate technology with teaching. The absence of teacher involvement has been a significant contributor to the failures encountered in several ed-tech initiatives (Edwards, 2019).

The teacher-tablet model was pioneered by Bridge International Academies, a for-profit company running schools in some African countries. Bridge's teachers are given tablets loaded with detailed lesson plans and instructions written by Bridge staff in the U.S., which teachers recite. The model has improved test scores among students. Piper agreed that Bridge-type models could be problematic if the technology is designed to be teacher-proof. Technology needs to be designed to help the teacher to teach better, as opposed to a lot of the designs of these tablet-based programs which is 'how do I skip the teacher?' he said (Edwards, 2019).

The field of education in the least-developed countries witnessed a groundbreaking experiment in 2017. Rather than participate in the sprawling, traditional teacher-led classes, up to 200 students at a time, a group of students filters into a learning centers within schools. Here, they engaged with math or reading instructional software on solar-powered tablets for 45-minute sessions. Organizations from the famed XPRIZE to the non-profit Imagine Worldwide are testing the proposition in Malawi in Southeast Africa. Although the likelihood of success is low, if the studies prove to be effective, the global implications will be far-reaching (Horn, 2019). XPRIZE sought to tackle these educational challenges through its Global Learning prize. This initiative launched a competition centered on creating "open-source, scalable software facilitating independent acquisition of fundamental literacy and numeracy skills by children in developing countries within 15 months." Five finalists were chosen in 2017, each receiving a $1 million monetary award. The aim was to develop software that could impart essential reading and numeracy skills through tablet devices, without direct adult supervision. These software designs were implemented among 2,700 children across 170 remote settlements in eastern Tanzania through collaboration with the United Nations (Horn, 2019).

Integrating tablet computers into educational systems is crucial for countries aiming to progress from developing to developed status. However, the high cost of tablets poses a significant challenge, especially in low-income countries. To address this issue, numerous initiatives in developing nations have been initiated to reduce the cost of these devices.

2.2 Tablet Computer Industry in Egypt

2.2.1 Statistics of the Tablet Market in Egypt

Understanding Egypt's domestic Tablet industry necessitates an in-depth analysis of the Egyptian market, rooted in demographic insights. Demographic analysis involves studying and gathering data on population characteristics, descriptions, and income to comprehend behavior and preferences. This segmentation aids in estimating potential market sizes (Hayes, 2022). Presently, Egypt boasts a population exceeding 104 million, with 57% residing in rural areas and 43% in urban centers (CAPMAS, 2022). This population demonstrates an average growth rate of approximately 2% and is anticipated to reach 150 million by 2050 (Statista, 2022). The structure of this population is shown in Fig. 4, while Fig. 5 forecasts the anticipated structure by 2050. Notably, the youth, encompassing individuals aged 14 to 40, is projected to represent nearly 38% of the total population (Fitch Solutions, 2020). Moreover, the annual per capita income for Egyptian citizens stands at approximately EGP 20,271 thousand (equivalent to $1,086) (CAPMAS, 2022; Levin et al., 2023). These

demographic insights lay a crucial foundation for comprehending Egypt's tablet market and its potential significance within the domestic industry landscape.

Fig. 6 shows the market share of tablet computer vendors in Egypt across the years from 2016 to 2022. In 2016, Samsung dominated the Egyptian tablet market with a 49% market share, followed by Apple with a 39% market share. Although Samsung's market share gradually declined over the following years, it continued to lead until 2017. However, in 2018, Apple surged ahead, capturing 44.4% of the market share, while Samsung accounted for approximately 39%. Since 2019, Samsung has reasserted its dominance, consistently controlling over half of the Egyptian tablet computer market. Additionally, by the close of 2019, Huawei made significant strides, gaining nearly 8% of the market share.

The strategic geographic location of Egypt has positioned it as a pivotal distribution hub for companies eyeing the Middle East and Africa regions. Considering this perspective, let's delve briefly into the tablet computer market across the Middle East and Africa. Fig. 7 shows the number of tablet users in the Middle East and Africa from 2016 to 2019. Every year, the number of users grows by about 15 million. While the data might be somewhat dated, it underscores the sustained and robust annual growth witnessed in the region's tablet user base.

Returning to the Egyptian domestic market, the high cost of tablet computers, combined with Egyptian citizens' low per capita income, resulted in significant changes in PC market share and a shift in the types of owned devices, as illustrated in Fig. 8. The fluctuations in tablet sales, particularly notable in 2016, were attributed to government procurement following the signing of a protocol. This protocol aimed to supply Egyptian schools with a staggering 20 million tablet computers, allocating two million for teachers and a substantial 18 million for students.

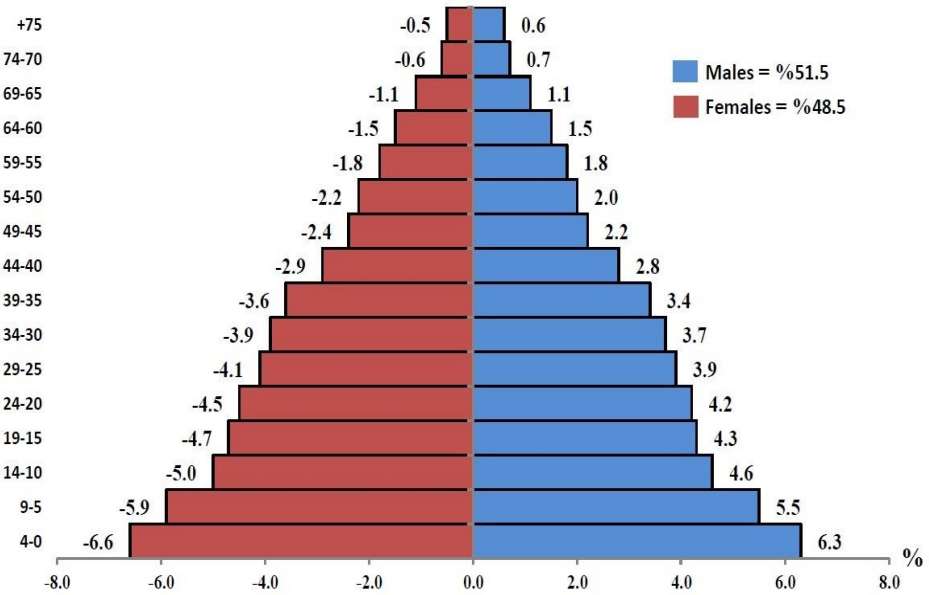

Fig. 4: Egypt population pyramid (Sources: Fitch Solutions, 2020)

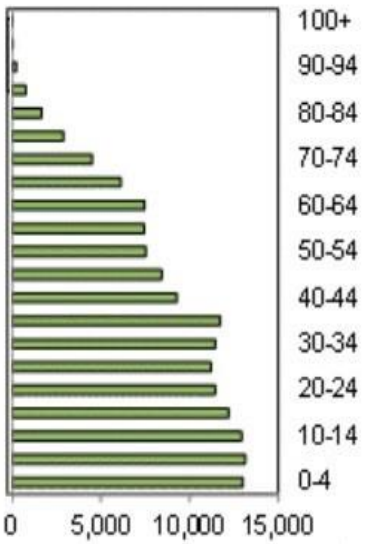

Fig. 5: Expected Egypt population pyramid in 2050 (Sources: Fitch Solutions, 2020)

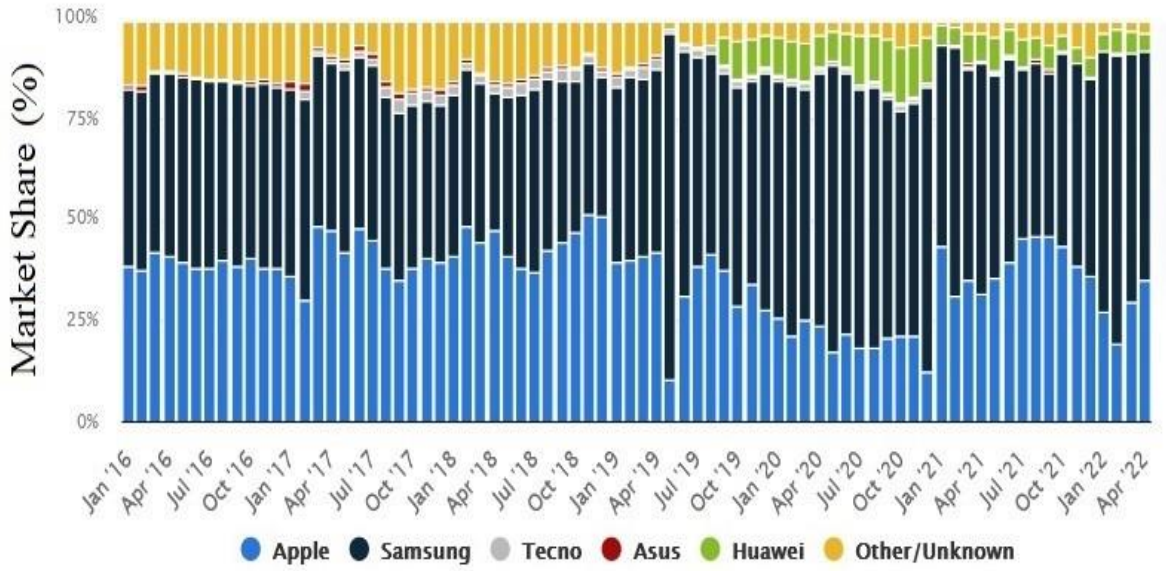

Fig. 6: Tablet computer vendor market share in Egypt from 2016 to 2022 (Sources: Statistia, 2022)

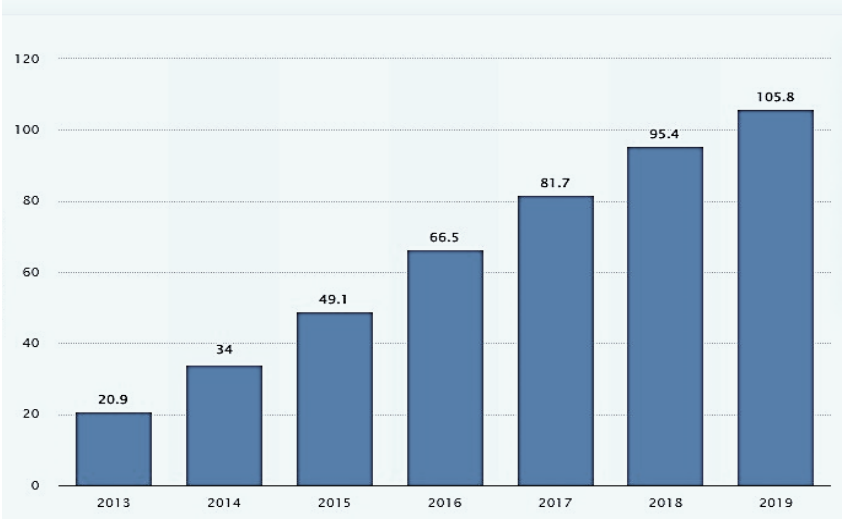

Fig. 7: Number of tablet users in Middle East and Africa (Sources: Fitch Solutions, 2020)

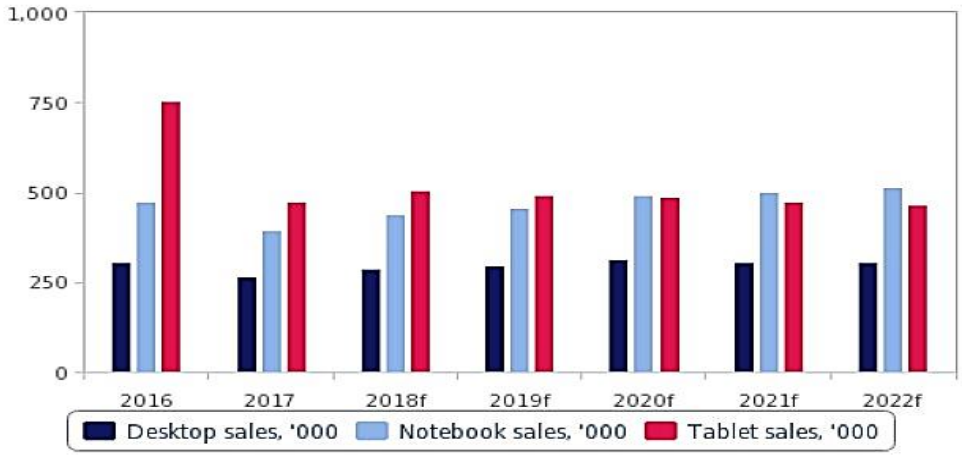

Fig. 8: PC volume forecast (Fitch Solutions, Egypt information technology report — q1 2019, 2019)

2.2.2 Manufacturing Tablet Computers in Egypt

In 2011, the concept of creating an Egyptian tablet emerged. Initially, a team of engineers travelled to the United States, Germany, and China for training across diverse factories, including Foxconn, renowned for assembling Apple devices. Subsequently, this team established three technological axes for the Tablet computer industry in Egypt: a) domestic manufacturing, b) joint production, and c) contracting with international manufacturing companies.

For the first axis, domestic manufacturing, the Egyptian government chose Benha Company for Electronic Industries, Ministry of Military Production, to produce the first Egyptian Tablet computer. In 2013, they announced the production of the first Egyptian tablet, *Inar*. This tablet came in two versions: one tailored for school students as part of an educational support initiative by the Ministry, and the other version targeting the general consumer market, released in 2014. Notably, the key disparity between the two versions lay in the latter's enhanced specifications, featuring dual front cameras with a resolution of two megapixels, a rear camera capable of five megapixels, SIM card compatibility, and Bluetooth technology (Egypt Business Directory, 2013). Another Tablet with an Intel processor was produced by the Arab Organization for industrialization, named *pluto* (Morsy, 2018). Since then, there has been no advancement in these Tablet computers, i.e., Inar and Pluto, nor releasing any other new devices. Domestic Tablet computer production continued in 2018 with the introduction of the *SICO Express-3*. It was created in collaboration with the world's most prominent technology providers, including Intel, Qualcomm, Spreadtrum, and Microsoft. Impressively, 45% of the tablet's components were sourced locally, while the remainder were obtained through a partnership with China. The assembly process involved the motherboard as the initial component, followed by the assembly and calibration of the touchscreen. Rigorous testing utilizing state-of-the-art equipment ensured the tablet's quality (Sico Technology, 2021). Table 2 shows the technical specification of different domestic Egyptian tablets.

The second axis, centered on joint production, seeks to enhance collaboration between the public and private sectors to localize Egypt's electronics industry. Aligned with the presidential initiative "Egypt manufactures electronics," its core objective is to bolster local manufacturing, amplify the value of manufactured products, and aim for a twofold increase in Egyptian electronics exports (Egypt Independent, 2021). This initiative represents a targeted strategy to position Egypt as a prominent hub for regional electronics design and manufacturing, focusing specifically on the tablet computer industry. However, in this paper, we are only concerned with the tablet computer industry. In 2011, the Arab Organization for Industrialization announced a collaboration with the Talal Abu-Ghazaleh Organization to develop tablet computers. This collaboration is driven by the ambition to craft the first Arab tablet computer with robust specifications capable of meeting global market demands, thereby competing effectively with renowned brands (Ministry of Trade and Industry in Egypt, 2021).

The joint collaboration's annual target production target exceeds 500,000 devices, with a potential doubling of capacity in response to market demands. Notably, the entire manufacturing process is driven by the Egyptian workforce. While the manufactured devices target the global market, but they will first be distributed in Arab and African countries. The collaboration will then benefit more than 100 distributors in South America who represent the Talal Abu-Ghazaleh Organization in order to expand the device market within these regions. Furthermore, more than 50 authorized distributors from various countries will facilitate the distribution of these tablet computers worldwide (Almal News, 2021).

The third axis, involving partnerships with international manufacturing companies, aims to entice foreign companies specializing in tablet computer manufacturing to invest in Egypt. The Ministry of Communications and Information Technology has taken on the responsibility of attracting world-leading companies to establish and operate new factories in this field and transferring expertise, technological skills, and training to local labour. They took this initiative in order to meet the Egyptian state's great demand for educational tablets at this phase and in the coming stage. In pursuit of this goal, the ministry negotiated and finalized a contract with South Korean giant Samsung Electronics, acting on behalf of the Egyptian government, to inaugurate a new production facility in Beni Suef. With a total capital investment of $30 million, this factory is dedicated to manufacturing educational tablet computers. The negotiation process involved extensive discussions with leading players in the electronic manufacturing industry. The establishment of this factory is expected to generate over 500 job opportunities for Egyptian workers and provide training for approximately 1000 Egyptian technicians, allowing them to stay abreast of the latest technological advancements. Commencing production in March 2022, the newly established plant is projected to manufacture one million tablet computers annually. Notably, the specifications of the educational tablets will undergo updates every two years, as stipulated in the five-year contract, while maintaining a cost not exceeding 1400 Egyptian pounds ($80) per unit (MCIT, 2021; Arab News, 2021).

Meanwhile, the Egyptian government is actively pursuing Chinese electronic companies that are considering relocating from India, particularly amidst the ongoing tensions between these companies and the Indian government (Mikhail, 2022; Daye, 2022). Currently, two Chinese companies, i.e., Vivo and Oppo, have disclosed their intentions to establish their respective electronics manufacturing plants in Egypt. These facilities are earmarked for the Industrial Zone of the Tenth of Ramadan and will involve a combined investment totaling $50 million ($20 million from Vivo and $30 million from Oppo) (El-Din, 2022).

Table 2: Technical specification of different domestic Egyptian tablets

	Inar v1	Inar v2	Pluto	SICO
Operating system	Android	Android	Android	Windows, Android
CPU	Single-core (1.6 GHz)	Dual-core (1 GHz)	Single-core (1.6 GHz)	Quad-core (1.2GHz)
Internal memory	32 GB	8 GB	16 GB	8 GB
Ram	1 GB	1 GB	1 GB	1 GB
Screen (inch)	9.7	9.7	10	7
Screen resolution (pixels)	1024*720	1024*768	1280x800	1024*600
External memory	N/A	up to 32G	up to 32G	up to 32G
Communication	Wifi	Wifi	Wifi, Bluetooth	Wifi, Bluetooth-4, GPS
Front camera	0.3M	2M	0.3M	0.3M
Rear camera	2MP	5MP	2MP	2MP
Battery (mAh)	-	7800	6600	2800
Weight (grams)	750	750	685	654

2.3 Tablets Industry in India

2.3.1 Statistics of Tablet Market in India

India currently has a population of more than 1411 million people, with 65.5% of them living in rural areas and 34.5% living in cities (India Government, 2022). This population has an average growth rate of approximately 8.7% and is expected to reach around 1.639 million by the year 2050 (India Government, Population pyramid of india from 1950 to 2100, 2022). The structure of this population is shown in Fig. 9. In 2050, the youth, or those aged 14 to 40, will account for nearly 34.2% of the total population (India Government, Population pyramid of India from 1950 to 2100, 2022). Finally, the annual per capita income for Indian citizens stands at approximately $2277 (World Bank & OECD, 2022).

Fig. 10 shows the market share of tablet computer vendors in India from 2016 to 2022. In 2016, Samsung held a dominant position in the Egyptian tablet market with a 35.68% market share, followed by Apple with 32.8%. However, in 2018, Apple took the lead, securing 39.05% of the market share, while Samsung's share dipped to around 32.5%. Since 2020, Samsung has regained its dominance, commanding over 40% of the Indian tablet computer market. It is worth noting that the term “unknown” in Fig. 10 refers to domestically manufactured tablets, which secured the third-largest market share during this period. Furthermore, from the end of 2016 to the end of 2020, two companies, Kupa and eStar, captured a considerable portion of the market share. Kupa, a Chinese company, specializes in selling budget-friendly tablets, while eStar focuses on marketing low-cost educational tablet computers (eSTAR, 2022).

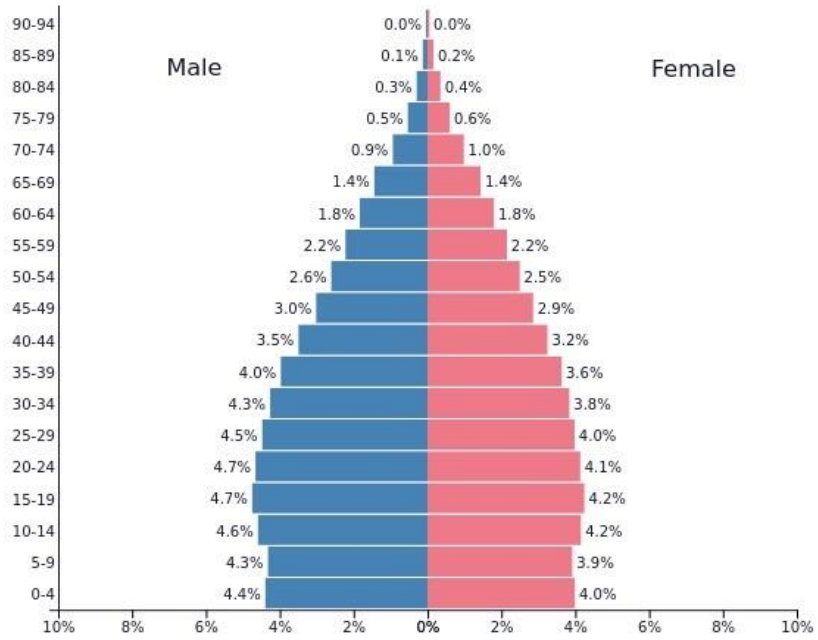

Fig. 9: India population pyramid (Sources: India government, population pyramid of India from 1950 to 2100, 2022)

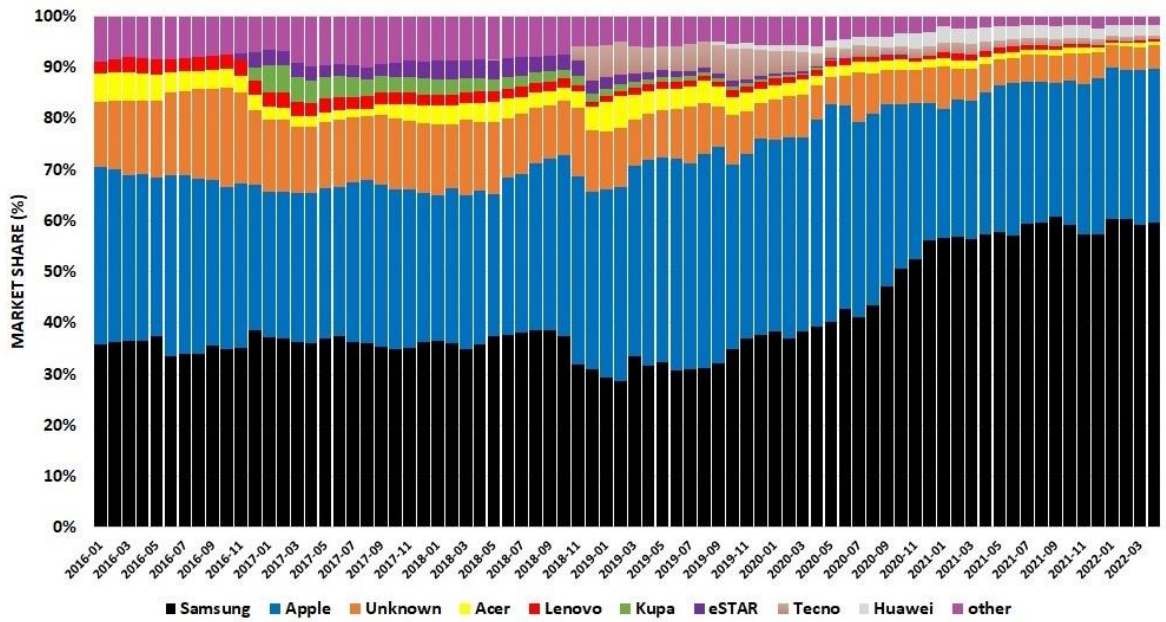

Fig. 10: Tablet computer vendor market share in India from 2016 to 2022 (Sources: Statcounter GlobalStats, 2022)

2.3.2 Electronics Manufacturing Initiative

In 2012, India initiated the National Policy on Electronics (NPE) to oversee the electronics hardware industry and foster domestic manufacturing. The ambit of electronic hardware production targeted for localization includes intricate microchips, flat-screen monitors, electronic components, laptops, and tablets (Patel, 2020). But, they recognized that the production of semiconductors is the most critical component of the hardware industry (Patel, 2020). Such production demands impeccable infrastructure, particularly in terms of consistent electricity and water supplies. As a preliminary step, India began supporting the development of top-tier infrastructure to allure capital investments into the Electronic System Design and Manufacturing (ESDM) sector, aiming to establish India as a global contender in electronics manufacturing. During this phase, important government initiatives such as the National Optic Fiber Network, the National Knowledge Network, and the unique identification authority of India (UIDAI) project were launched. Concurrently, investors who chose to invest in the developed clusters received a cost advantage of 5% to 8%. This cost reduction is due to increased supply chain responsiveness, solidification of supplier, reduced time-to-market, superior access to talent, and decreased logistics costs (Patel, 2020). These endeavors were instrumental in promoting domestic manufacturing in India, exemplified by the introduction of the "Aakash" tablet—a budget-friendly 7-inch tablet powered by an Arm processor and operating on the Android platform. Moreover, concerted efforts were made to expand career opportunities in electronics design, manufacturing, repair, maintenance, sales, and marketing of locally manufactured electronics.

In 2014, the Indian Prime Minister introduced the "Make in India" initiative with the aim of positioning India as a prominent global manufacturing center, thereby bolstering the nation's economy. This program has successfully attracted international investments from major companies such as Oppo, Huawei, Foxconn, Samsung, Dell, and Xiaomi, reshaping India into an emerging global manufacturing hub (India Brand Equity Foundation, 2022). The electronics devices industry in India is presently valued at $118 billion, marking a significant increase. India's share of the global electronic systems manufacturing industry has surged from 1.3% in 2012 to 3.6% in 2019, illustrating substantial growth and prominence on the global stage (Arora & Siddiqui, 2022).

In pursuit of enhancing exports, the Indian government has implemented various measures aimed at improving trade within the electronics hardware sector. The Electronics Hardware Technology Park (EHTP) units, operating within Special Economic Zones (SEZs), were established to facilitate hassle-free manufacturing and trading for export purposes. SEZ units benefit from a comprehensive income tax exemption, including 100% exemption on profits for an extended period, followed by a 50% exemption for the subsequent five years, along with other repaid benefits. Additionally, the EHTP Scheme was devised as a cost-effective strategy to facilitate electronic goods assembly. The Foreign Trade Policy introduced the Merchandise Exports from India Scheme (MEIS) to offer incentives for electronic goods' costs. Various schemes, such as duty exemption systems, the Export Promotion Capital Goods (EPCG) scheme, the Duty-Free Import Authorization (DFIA) scheme, and Deemed Exports, have been implemented to augment electronics exports. These initiatives have resulted in significant advancements, showcasing progress in trade during 2017-18 compared to the previous fiscal year (Bhat & Hugar, 2021). On the other hand, the Indian government pledged in March 2021 to provide one billion dollars in cash incentives to each semiconductor manufacturer that established operations in India.

(Foundation, 2021). This boosts Indian electronics exports, which are currently worth $10.6 billion (Arora & Siddiqui, 2022). Table 3 shows India's production and exports of computer hardware from 2005 to 2020.

According to Rice and Mahmoud (2013), the inability to export electronic hardware to international markets is due to the following factors:

- Inadequacy of support policy initiatives
- Technologically primitive
- Poor fundamental infrastructure
- Domestic investment inadequacy
- Incapability to attract foreign investment from multinational corporations
- Lack of manufacturing on a large scale
- Pricing products competitively
- Absence of domestic market growth trends that are robust
- Lack of acceptable profit margins
- Lack of global brand recognition
- Insufficient advertising campaigns
- The absence of a market strategy
- Absence of initiatives to develop new products
- Insufficient research and development funding
- The absence of global strategic partnerships

The increase in India's tablet computer services exports contributes significantly to gross domestic product (GDP), creates a new entrepreneurial class, reverses brain drain, raises the value of India's brand, and attracts direct investment from abroad.

2.3.3 Manufacturing Tablet Computers in India

Due to the significance of portable devices in education, especially in developing nations, India actively promoted the domestic production of tablets. Initially, the government facilitated this by waiving duties and taxes while subsidizing the cost by 50%. In 2011, the Indian government launched the 'Aakash' tablet program aimed at enhancing the quality of education in the country. The 'Aakash' initiative, offering a low-cost tablet priced at $35, sought to provide an Information and Communication Technology (ICT) learning tool to more than 220 million students across India (Raman et al., 2014). The 'Aakash' tablet boasted a 7-inch touchscreen, an ARM 11 processor, 256 MB RAM, and a battery life of three hours. Equipped with two USB ports and support for high-definition (HD) video, the device was intended to facilitate modern learning methods. The project was spearheaded by Prem Kumar Kalra from the Indian Institute of Technology-Rajasthan. The manufacturing contract, valued at $4.3 million, was awarded to the Canadian company DataWind to produce 100,000 units of the 'Aakash.' However, during testing, approximately one-third of the devices failed to start. Nonetheless, this government initiative served as a catalyst, prompting Indian companies to embark on developing their own tablet computers.

Table 3: India's computer hardware production and exports

Year	Production (Billion U.S.$)	Exports (Billion U.S.$)
2005	1.96	0.267
2006	2.44	0.232
2007	2.96	0.347
2008	3.94	0.246
2009	2.93	0.359
2010	3.04	0.401
2011	3.29	0.285
2015	2.56	0.346
2016	2.62	0.358
2017	2.75	0.262
2018	2.73	0.330
2019	2.77	0.346
2020	2.83	0.347

*Source: Statista & Electronics and Software Export Promotion Council, Statistical Year Book

For Instance, iBall, India's premier homegrown tech accessory brand, was founded in 2001 (iBall, 2022). Historically, they began with only one product category: computer mice, before expanding into the mobile phone market

in 2010. However, because of the advantages provided by the Indian government, they entered the Tablet computer market in 2011 with their own product known as the iBall slide. Their products are appealing in a price-sensitive market, which results in increasing their market share to 15.6% in the fourth quarter of 2014 (Harjani, 2015). iBall strategically targeted educational institutions, an untapped market segment that larger companies like Samsung struggled to penetrate due to their higher-priced offerings. Table 4 provides a comparative analysis of Indian tablet brands, including iBall, lava, and Micromax (Gadgets Now, 2022).

Table 4: Comparison between Indian tablets brands in 2022

Specification	Lava Xtron Z704	iBall Slide 3G Q7218	Micromax Canvas Tab P681
Launch date	October 2014	November 2014	September 2016
Operating system	Android v4.4	Android v4.4	Android v6.0
CPU	Quad core (1.3 GHz)	Quad core (1.3 GHz)	Quad core (1.3 GHz)
Internal memory	16 GB	8 GB	16 GB
Ram	1 GB	512 MB	1 GB
Screen (inch)	7	7	8
Screen resolution (pixels)	1024 * 600	800 * 480	1280 * 800
External memory	up to 32 GB	up to 32 GB	up to 32 GB
Communication	Wifi, Bluetooth, Gps, Hdmi	Wifi, Bluetooth, Gps, Hdmi	Wifi, Bluetooth, Gps
Front camera	0.3MP	0.3MP	2MP
Rear camera	2MP	2MP	5MP
Battery (mAh)	4000	2500	4000
Weight (grams)	320	640	318
Other sensors	Accelerometer	-	Light and Proximity sensors, Accelerometer
Price (US $)	80	90	97

India has engaged in contracts with international tablet manufacturing companies to produce their devices within the country. Notably, the Samsung Galaxy Tablet "Made in India" was launched in 2016. This tablet mirrored the specifications of the international Galaxy Tab A, featuring a 7-inch display with a resolution of 1280 x 800 pixels, 1.5GB RAM, a quad-core 1.3GHz processor, 8GB built-in storage, a microSD card slot, an 8MP primary camera, and a 5MP front-facing camera (Tech Desk News Agency, 2016). In 2021, Lenovo collaborated with Wingtech Technology to establish a specialized manufacturing company dedicated to producing tablets catering to both consumer needs and specialized functions in sectors like retail, manufacturing, and healthcare. The "Made in India" Lenovo Tab K10 was introduced in 2021 with impressive specifications: a 10.3-inch FHD multi-touch display boasting 1920 x 1200 pixels resolution, an Octa-Core processor, a robust 7500 mAh battery, up to 4 GB RAM + 128 GB memory, an 8 MP rear camera equipped with Flash, and a 5 MP front-facing camera. Additionally, other prominent companies such as Apple, Acer, Asus, Panasonic, and LG have also established factories in India, signaling a growing trend of international manufacturers investing in local production within the country (Warke, 2021).

3. Results and Discussion

3.1 Challenges and Opportunities for the Tablet Industry in Egypt

Certainly, when comparing Egypt and India's initiatives in producing tablet computers locally, it's evident that India has made significant strides and achieved better results in this sector. India's multifaceted initiatives in technology, economics, and capacity building have positioned it ahead of Egypt in this domain.

The following points summarize the issues confronting Egypt’s technological reality in the Tablet industry:

- Availability of specialized technicians capable of working on the latest technologies
- Establishing the manufacturing capacity for major electronic components
- Access to local, Arab, and international markets to absorb production capabilities and facilitate exports
- Implementing laws and regulations to safeguard the intellectual property of manufactured tablets

In subsequent subsections, considering India’s success in localizing the Tablet computer industry, we discuss various challenges for the Egyptian Tablet industry. These challenges will be categorized into technological and developmental aspects, aligning with each axis mentioned in section 3; domestic manufacturing, joint production, and contracting international manufacturing companies.

3.2 First Axis: Domestic Manufacturing

3.2.1 Challenges

Several issues and barriers to the localization of the tablet industry in Egypt. Despite the Egyptian government's efforts, it remains difficult for an investor to invest in tablet computer manufacturing. For example, it is still difficult to find adequate land to build a factory; even if you do, it will be very expensive. Furthermore, duties and taxes remain extremely high, and investors must obtain numerous permits before establishing a business. However, recognizing these challenges, the Egyptian government has recently taken steps to incentivize and attract manufacturers. These efforts include the provision of protection incentives and the establishment of the Science and Technology Park for Electronics Research & Industry (STPERI) within the Electronics Research Institute.

In the realm of industrial research and development within tablet computer manufacturing, Egypt faces certain shortcomings. For example, the Egyptian tablet *Inar* is heavy (750 grams) when compared to other Tablets, such as the *iPad 4* (650 grams) and the *Note 10.1* (600 grams). Additionally, there are noticeable performance slowdowns, especially when running multiple applications simultaneously. However, efforts have been initiated within the Department of Microelectronics within the ERI has recently turned to low-power processors research (Mahmoud et al., 2018; Ellaithy et al., 2017).

3.2.2 Suggested Solutions

To tackle the challenges facing the Egyptian tablet industry, the Egyptian government must take additional steps. Following we propose some remedies to forfeit the challenges:

- Providing incentives and protection for domestic manufacturers to compete with imported goods, such as duty and tax reductions.
- Creating a specialized city for electronic manufacturing, with areas dedicated to Tablet computer manufacturing.
- Raising awareness of industrial research in electronic manufacturing.
- Periodic product evaluation and continuous product development in response to market developments.
- Marketing of Egyptian Tablet computers, particularly in the local market.

3.3 Second Axis: Joint Production

3.3.1 Challenges

This axis aims to integrate the private sector in tablet computer production, particularly targeting the international market. As a result, there will be product quality competition with the foreign market, and products will be priced based on their quality and in comparison to other products. As a result, the challenge here is to create a device that can compete in terms of both quality and price against well-established and renowned tablet computers.

3.3.2 Suggested Solutions

To address the challenge of securing international market share for Egyptian tablet computers, the following strategies can be instrumental:

- Segmenting the international market into groups, each representing a niche. After that, conduct an analysis of each niche's needs and how to meet those needs in terms of quality and price.
- Continuous and close monitoring of international market changes and demands.
- Ongoing development of Egyptian Tablet computers.

3.4 Third Axis: Contracting International Manufacturing Companies

3.4.1 Challenges

The Egyptian government's collaboration with "Samsung Electronics" to establish a new production factory in Beni Suef aimed at manufacturing educational tablet computers signifies a significant step toward fostering local electronic manufacturing. Furthermore, it is not easy to encourage foreign investments from big firms, such as Samsung, to establish a factory in Egypt that will help provide job opportunities and good training in electronic manufacturing for Egyptian workers. Many facilities and incentives should be provided to entice these companies to invest in Egypt. Furthermore, trade name ownership often remains with the foreign entity. This aspect can present challenges in fully claiming the production as domestic manufacturing, impacting the perception and ownership of the products in the market.

3.4.2 Suggested Solutions

Absolutely, implementing a long-term strategy that focuses on knowledge transfer and capacity building is pivotal for the success of collaborations between international companies like Samsung and the Egyptian government in the electronics manufacturing sector. For these partnerships to be mutually beneficial, it's essential to integrate Egyptian

researchers into the research and development (R&D) teams of these international companies. This collaboration facilitates the exchange of knowledge, expertise, and advanced technological insights, contributing to the skill enhancement and professional development of Egyptian researchers. Additionally, providing cutting-edge technology training to Egyptian workers as part of the employment conditions or through specialized training programs is crucial. This training should focus on the latest manufacturing techniques, technology applications, and industry standards, ensuring that Egyptian workers acquire relevant skills that align with global industry practices.

Moreover, establishing specialized schools or vocational training centers dedicated to educating Egyptian students in the field of electronics manufacturing can be immensely beneficial. These institutions can offer specialized courses designed in collaboration with international companies, providing students with hands-on experience, practical skills, and exposure to modern technologies, preparing them for careers in the sector.

4. Conclusion

This paper examines the Tablet computer industry in two developing nations, Egypt and India, which aim to incorporate Tablet computers into their educational systems. The review outlines the present state of the Tablet industry in each country and discusses the diverse strategies employed to establish and adapt this industry locally. Despite both countries' endeavors, India surpasses Egypt in this realm. We highlight the challenges faced by Egypt's industry and propose recommendations to enhance this crucial sector, especially in the realm of education.

The future development prospects for the tablet industry in Egypt can be articulated into several achievable goals: Bringing together research institutes and universities to conduct collaborative industrial research, collaboration between research and industry bodies to better understand industrial needs, finding marketing opportunities for research products - by assisting research institutes and universities in marketing product prototypes to industrial bodies that can benefit from them, collaboration between Egyptian research institutes and foreign research and development institutes, encouraging foreign direct investment to improve Egyptian workers' skills, lowering tariffs on manufacturing components, and focus on designing electronic components, facilitate the development of software.

The adoption of green and cyclical economies not only contributes to environmental conservation but also holds the potential to reduce the cost of tablet computers while adding value to Egyptian-made devices (Mohamed, 2019). Initiatives in this area, such as the Green Electrobekia at the Electronic Research Institute (ERI), exemplify Egypt's commitment to sustainable electronic waste management (Abdelbasir et al., 2022). The Green Electrobekia incubator, supported by the ERI and funded by the Centre for Environment and Development for the Arab Region and Europe (CEDARI), focuses on electronic waste recycling. This pioneering governmental incubator aims to establish start-up companies dedicated to electronic waste treatment, recycling, and management. Over a one-year incubation program, the initiative targets environmentally friendly treatment methods for electrical and electronic products. Specifically, the initiative involves the collection of old electronic devices for operational component testing, intending to disassemble and reuse these parts in other devices or refurbish them. Furthermore, it has developed a training course on electronic waste management, dismantling, and refurbishment, serving as educational material for technical colleagues. Expanding on these initiatives, it is recommended to develop specialized programs focused on devices like tablet computers. By enhancing knowledge in maintaining and refurbishing these devices, the initiatives can reduce manufacturing costs while promoting sustainability in the electronics industry. Moreover, collaborative efforts between ERI, CEDARI, and the Ministry of Communications and Information Technology in Egypt have initiated the development of an educational curriculum dedicated to refurbishing electronic devices. This effort includes the establishment of a laboratory and an incubator, demonstrating a concerted effort towards promoting sustainable practices in the electronics sector.

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