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A UNESCO 'ARAB SCIENCE, TECHNOLOGY AND INNOVATION (STI) FACILITY': A KEY TO BUILDING AN INNOVATION ECONOMY IN THE ARAB REGION

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ABSTRACT

PURPOSE: The Arab region has generally failed to catalyse and convert knowledge production into innovation effectively, and/or add value to products and services in the different economic sectors. Insufficient government commitment for science, technology and innovation (STI) and research, poorly designed national STI policies, and government that is ineffective in doing business are some of the factors causing these disparities. This paper identifies the main areas on which the Arab Countries should focus to allow innovation to take off towards a knowledge-based society in the region.

DESIGN/METHODOLOGY/APPROACH: This study adopts the comparative analysis approach to identify best practices and successful experiences from other regions of the world, and map the results to the particulars of the Arab region to identify discrepancies in public policy and institutional structures of the different national STI platforms in the region.

FINDINGS: The Arab countries face a host of hurdles, including a lack of focus in research priorities and strategies, little awareness of the importance of good scientific research, inadequate networking, limited collaborative efforts and brain drain, a disconnect between policymakers, scientists and society in generating, sharing and utilizing scientific knowledge, and, to a higher extent, insufficient funding and a lack of the required technical workforce. Lack of the technical 'critical

mass' in specific/priority areas of research, and similarly in certain productive economic sectors, has greatly affected these sectors region-wide.

ORIGINALITY/VALUE: While most of the current research has addressed the existing impediments to innovation from the government viewpoint and associated inter-governmental bodies such as the League of Arab States (LAS), this research focusses on the private sector and non-governmental solution modalities to create the necessary innovation and entrepreneurship culture in the region.

PRACTICAL IMPLICATIONS: Recommendations are made to create synergies between international organizations and private sectors. This is done by using out-of-the-box innovative financial solutions by the private sector through making periodic small donations under their social responsibilities budget. They do this in order to institutionalize a regional mega capacity building programme to develop the required technical critical mass, which is needed to support the development of the sought regional manufacturing capabilities that can compete with the international markets.

KEYWORDS: Innovation; Knowledge-based; STI policies; Resource Mobilization; Manufacturability.

INTRODUCTION

Harnessing adequate technologies to innovate the production of quality modern goods and services of higher added value is the essence of an 'innovation and knowledge based economy'. Centuries ago, Arab States were the hub of ground-breaking science. Today, they spend less on research and development (R&D) than any other region (0.3% compared to 0.41% for the sub-Saharan region): this is one of the major reasons young scientists are seeking greener pastures in the West. In the face of increasing insecurity over food, water and energy, however, even those Arab States dependent on oil revenue will have no choice but to espouse science and technology (S&T) to attain sustainable development. If they do not want to be left behind by the knowledge economy, they will have to invest in innovation. Strong national and regional capacities in STI will be essential to addressing the development priorities of the region.

While all Arab countries have sectoral policies, such as those for agriculture, water resources and the environment, most of these countries today can be categorized by an absence of effective national strategies for science, technology and innovation (STI), poor coordination between public and private R&D sectors, and little innovation due to the weak linkages and the absence of substantive partnerships between academia, research institutes and the productive sectors, which constitute the pillars of any national innovation system. In addition, the environment is not conducive to innovation as Arab countries rank low in indicators for the ease of doing business. Where S&T policies do exist, they are either too ambitious and/or ambiguous, and the innovation part is still quite absent.

Why should any Arab country have an STI agenda to start with? And how could such agenda and related policy(s) become effective to reap the socio-economic development objectives desired at both the national and regional levels? The example of Malaysia, from beyond the Arab world, is often cited by Arab decision-makers as a developing country that has achieved the desired economic success thanks, in part, to the contribution of S&T. In 1992, the former prime minister of Malaysia, Dr Mahathir Muhammad, announced that the sole objective of the Malaysian S&T policy was to help Malaysia become fully developed by the year 2020. This has been achieved to a great extent by 2015. Following suit, the scientific and technological communities within the region strongly recommended a paradigm shift to coordinate and enhance the STI role towards a practical roadmap that will achieve progress towards a knowledge-based economy and sustainable development. STI is of critical significance for sustainable development in all its dimensions – economic, social and environmental. Through research, sciences support all technological innovation and engineering solutions needed to address contemporary challenges; these include environmental degradation and restoration, water issues and energy needs.

In context of the above, a coherent long-term science and research agenda needs to be developed for sustainable development in the Arab States, containing a clear vision, mission, strategy and a pre-defined portfolio of multi-sectoral projects. All national and regional efforts of the involved institutes and researchers should be directed towards this agenda, which should contain the following elements:

- Holistic, trans-disciplinary scientific approaches, which address the interconnections between environmental, social and economic issues;
- Solution-orientated scientific programmes that expressly serve national and regional needs, and the relevant participatory processes through which science agendas are communicated to the targeted groups and stakeholders;
- Strategies to incentivize scientists and researchers to serve the public through applied, practical, market-based, pro-poor and relevant research;
- Easing the terms of doing business and releasing the forces of competition so as to support the best talents.

The portfolio of multi-sectoral projects and programmes, referred to above, should have similar attributes and objectives to the US Mega space programme contained within the 1960s US S&T policy. This policy was aimed at building the nation's technological capacities in several fields simultaneously in order to successfully allow putting a man on the moon. With the necessary political will, and making the necessary financial resources available, the US space programme succeeded in its mission six years after its inauguration.

THE ARAB STI PLATFORM: SITUATION ANALYSIS

(Hamze and Mrad, 2013; UNESCO, 2013; UN ESCWA, 2014)

While the Arab region has generally failed to catalyse knowledge production effectively or add value to products and services, disparities in scientific capacity and STI development levels within and between the countries of the region remain considerable. Some of the factors causing these disparities include:

- Insufficient government commitments for STI and research, including financing, technology and capacity;
- poorly designed national STI policies and lack of adequate organizational capacities to implement policies;
- lack of quality STI statistics and indicators;
- unequal participation of men and women in scientific fields;
- a lack of consistent life cycle thinking and long-term perspective in STI frameworks and policies;
- a disconnect between policymakers, scientists and society in generating, sharing and utilizing scientific knowledge;
- an ineffective government to ease doing business.

The Arab countries also face a host of hurdles, including a lack of focus in **research priorities and strategies**, little awareness of the importance of good scientific research, inadequate networking, limited collaborative efforts and brain drain, and, to a lesser extent, insufficient funding to meet research goals. It is clear from the available statistics that countries will need more sustained government support in future if they are to strengthen national research, overcome weak university-industry linkages, and give university graduates the professional and entrepreneurial skills to create viable national innovation systems. A lack of the technical 'critical mass' in specific/priority areas of research, and similarly in certain productive economic sectors, has greatly affected these sectors region-wide.

However, as investment in research and innovation is a policy choice, investment is greatly affected in countries where the State has control over the research circles. The political control of the knowledge sphere in many countries in the region has diminished the role of science and technology and its contribution towards achieving sustainable development and building the knowledge-based economy. This is not the case with countries demonstrating a long-term commitment to research, and where multiple actors/enterprises are seriously engaged in research and innovation. A good research system will usually possess a wide range of specialists and a substantive level of research diversification, which is a natural evolution from a handful of initial research activities growing and developing.

The importance of **scientific research** in the socioeconomic development of the region has to be underscored, as it is among the main players in enhancing the

competitiveness of the productive and services sectors towards an innovation economy. Many traditional industries require a technological base; this is because science today goes into equipment and skilled labour, with a higher degree of integration between the production processes and the technology used. Since production/manufacturability is indispensable, countries without a local productive base that includes highly skilled knowledge will not be able to compete or even follow towards the desired knowledge based economy.

The Arab Knowledge Report has been advocating for a closer relationship between academia, research and industry, which are the three pillars of any national innovation system, and other productive functions including agriculture. On another note, and while scientific collaboration is the very heart of the scientific activity and is necessary to advancing research and innovation at both the national and regional levels, the R&D sphere in many Arab countries could be described as a fragmented number of competence islands, where these islands of similar domains are relatively independent of one another. The scientists affiliated with these islands will seldom collaborate with national peers outside their own institutions, and hence the quality of national research remains weak and networking has been completely avoided.

In terms of output of the current **higher education system**, there is a clear mismatch between the skills the graduates acquire and those that the labour market demands. The oversupply of university graduates, and the channelling of students who perform poorly into **technical and vocational education and training (TVET)** (rather than acknowledging the key role qualified technicians play in the knowledge economy) are fuelling unemployment among tertiary graduates and leaving the market without skilled labour. There is, therefore, a growing call for increasing the quality and relevance of education, and for improving 'feeble' education areas, including secondary education, technical and vocational education, and tertiary education and research. Education systems need to be reviewed and updated, as the current system, which was designed for the particulars of the 20th century, are clearly falling short of meeting the knowledge society demands of the 21st century, such as strong analytical and problem-solving skills and creativity to innovate. Such a review should include content as well as the learning/teaching processes.

The current **higher education** curricula are mostly fact-heavy, lecture based, with limited use of ICT tools and little contextualization. This environment favours passive learning and examination-based assessments that measure students' ability to memorize knowledge and curriculum content rather than their ability to develop the necessary analytical skills and creativity to innovate. Teachers in general, and science teachers/educators in particular, need to adopt novel approaches that transform them from tele-promoters into facilitators. Any proposed action should aim to assist the Arab Member States in strengthening their institutional capacity-building for science and engineering, and the transformation

of higher education systems to more trans-disciplinary approaches so as to integrate the challenges of sustainable development into their research and educational agendas.

Fresh water remains a critical element of security, sustainability and peace, with its vital importance increasing due to, among other factors, demographic growth, urbanization and climate change. Issues of water use efficiency and governance, adequate and equal access, and water quality are top regional priorities that have an important impact on human well-being, the environment and overall economic development efforts. The sustainability of regional agro-food production is also under fire with the current over-exploitation of limited resources, coupled with food imports; this makes the region more susceptible to environmental and economic shocks. For the region to adopt sustainable and equitable resource exploitation, improve its consumption and production patterns, and move towards green economies, which are low carbon, resource efficient and resilient, the introduction and application of innovative green technologies are in order. This will allow socio-economic development to be successfully decoupled from the growing environmental degradation and the overuse of natural resources.

Securing access to **sustainable energy** for all in the Arab region is also among the vital basic services that are affecting development in the region. It is important for all Arab countries to invest more in energy efficiency and renewable energy applications, not only from a socio-economic perspective, but also in response to global concerns about climate change. Decision-makers also need to recognize that there is a strong direct link between energy production and water consumption. Water is required to convert energy resources into electricity, be it through thermal, nuclear, hydro, or other sources. In turn, energy is needed at all stages of water extraction, treatment, and distribution – in agriculture, water supply and sanitation, cooling, and many other systems. The issue of water-energy nexus in the region needs to be adequately addressed in an integrated inter-sectoral approach. The effect of climate change on water security needs to be well understood, and appropriate adaptation measures utilizing technological advancements should be presented to address all contemporary challenges, such as environmental degradation and restoration, water issues and energy needs.

ROOM FOR POLITICAL MANOEUVRE

Innovation is one of the most critical drivers for advancement in the social, economic and environmental spheres. Harnessing adequate technologies to produce quality modern goods and services of higher added value is the essence of an 'innovation and knowledge based economy'. To achieve these goals, a paradigm shift towards building and fostering the regional manufacturing capabilities is therefore in order. However, it should be borne in mind that such a shift will only be possible through the adoption of a coherent agenda that contains a portfolio of solution-orientated mega scientific projects and programmes that expressly serve

the region's needs. The process of building the required national technical critical mass to boost innovation in all strategic economic sectors towards sustainable development will need the involvement and support of all regional stakeholders and many of their international partners.

In March 2014, the Council of Arab Ministers of Higher Education and Scientific Research, at its 14th congress in Riyadh (Saudi Arabia), agreed to adopt the Arab Strategy for Science, Technology and Innovation (ASSTI) with an ambitious agenda. ASSTI urges member countries to engage in greater international co-operation in 14 scientific disciplines and strategic economic sectors, including convergent technologies such as bio-informatics and nano-biotechnology. The strategy has three main thrusts: academic training in science and engineering, scientific research, and regional and international scientific co-operation. One of the strategy's key objectives is the greater involvement of the private sector in regional and interdisciplinary collaboration, in order to add economic and development value to research and make better use of available expertise. The strategy also emphasizes public outreach by scientists, and greater investment in higher education and training to build a critical mass of experts and staunch the brain drain. It also advocates involving scientists from the Diaspora.

The strategy nevertheless eludes some core issues, including the delicate question of who will foot the hefty bill of implementing the adopted strategy. How can heavily indebted countries contribute to the proposed STI platform? What mechanisms should be put in place to combat poverty and offer greater equity of access to knowledge and wealth at national levels? Without carefully considered answers to these questions, coupled with innovative out-of-the-box solutions, no strategy will be able to exploit the region's capabilities effectively. For the soon to be ratified strategy to fly, the region's scientific community needs to elaborate on a number of innovative modalities through which the region will be able to strengthen STI governance. This will enable the support of effective contributions of science and knowledge in meeting societal needs and challenges, will help build the necessary ICT infrastructure to improve equity of access to information and multiply opportunities to create knowledge and wealth. It will also motivate youth to embrace sciences as their gateway to better livelihoods, and lastly, it will improve the regional cooperation and integration to ensure the creation of the necessary synergies for better utilization of the regional resources. The following are more specific examples of how the State could support and strengthen their National Innovation Systems (NIS):

1. The sustainable development of any enterprise must be based on innovation, R&D and technological development, areas which should be acknowledged as of special interest to the State. The State should also demonstrate and encourage a legal framework that could utilize public resources to foster the participation of the private sector and non-governmental institutions in research, bearing in mind that its national

technological development will benefit from such exceptional support measures. It is also vital to ensure the visibility of research as a State strategy towards sustainable development. This could be done through the re-structuring of the scientific community into one consolidated network of national research institutes, with clearly identified research teams and their associated capacities to generate new knowledge and have the ability and the readiness to undertake multi-sectoral projects of applied research with industry in pre-selected priority areas;

2. The agenda for science and research, which affects how knowledge is created and utilized, has always been political. The same is also true with issues such as fostering regional integration through the development of a common multilateral strategy involving research centres in different countries converging into one active regional research structure. As indicated in the Arab Knowledge Report, many of these research centres and institutions have been national endeavours with little multilateral cooperation within the region. This issue needs to be addressed to improve on regional cooperation and economic integration;
3. Despite Heads of State committing to raise spending on research and development to 1% of GDP more than 25 years ago, not a single Arab country has yet reached that target. Public budgets should clearly identify research as a goal, where research needs have been clearly identified. These public budgets should be utilized as a stabilizing means of allowing for high quality research, while growing its own resources. Funding research is a profession, and for research activities to be satisfactorily sustained, it would be favourable to devise new, more effective, systems of management for research and innovation;
4. The Arab region is actively exporting highly qualified human capital equipped with university degrees; therefore, many countries in the region are continuing to lose their winning ticket to development and progress. The motives may be economic or political but the result is the same: an exodus of experts and researchers from countries that have spent millions of dollars educating them. Researchers are not the only ones fleeing these countries, and there is no reason for them to remain hostages of Governments that do not care (or know how) to use their talents. If scientists seek greener pastures to exercise their talents, it is the governments' task to offer the best conditions to retain their technical workforce and researchers.

OPTIONS FOR THE WAY FORWARD

The newly adopted SDGs call for the optimal utilization of crucial drivers such as the creation and diffusion of technological knowledge and innovation to allow for

dynamic and sustainable activities to replace obsolete and inefficient patterns of production and consumption. The technological knowledge available to developing countries will largely determine their ability to generate dynamic, environmentally sustainable activities that will strengthen their productive capacities. In that context, a number of innovative modalities and models are presented below, with the aim to mobilize science and research to address complex and inter-related regional challenges of sustainable development including environment and climate issues.

1. Greater regional knowledge-sharing is critical to induce the transformative changes needed to address the complex and inter-related challenges of sustainable development. *This call to put into practice integrated approaches to science and engineering for sustainable development, is called 'sustainability science'*. These integrated, 'problem-solving' approaches draw on the full range of scientific, traditional and indigenous knowledge in a trans-disciplinary way to identify, understand and address economic, environmental, ethical and societal challenges;
2. Arab States should commit to *creating the required critical mass of experts and knowledge workers capable of developing and implementing innovative nationwide technological programmes that are aligned with national developmental priorities*. With the education systems being central in forming the required technical 'critical mass', galvanizing science and engineering education and scientific research in order to foster an innovation and techno-preneurship culture in the Arab Region are all a must. How will countries in the region embrace economic diversification without building a critical mass of experts, technicians and entrepreneurs?
3. *The science community in the region must strengthen its coherence, effectiveness and interoperability in order to tackle highly complex challenges with finite resources*. Partnerships will be increasingly essential for the effectiveness of any regional efforts to achieve the recently adopted SDGs. Through the implementation of the required action(s), the capacity of UNESCO to enter into innovative partnerships with a broad range of regional stakeholders and networks, including civil society, the private sector, media, foundations, parliamentarians, and networks of institutes and centres, and to engage with the regional and international financial institutions, should be strengthened and fostered;
4. Non-governmental organizations (NGOs), as platforms for strong civil engagement, are, more than ever, crucial partners of any intergovernmental organization, such as UNESCO, and need to act globally while at the same time linking the global to the local. UNESCO will promote a genuine culture of partnership with NGOs, renew and revitalize the network of NGOs, with new efficient, visible and action-oriented partnerships that put emphasis on the participatory approach in tackling regional sustainable development issues;

5. *New and innovative funding mechanisms from all possible funding sources, including self-benefitting modalities, must be sought to support the financial realities and constraints of many countries and organizations.* We have seen how Moroccan telecom operators support public research projects in telecommunications by ceding 0.25% of their turnover to a dedicated fund. It is, therefore, reasonable to institute an autonomous non-governmental science and research fund, with an annual token amount being collected from large companies and NGOs, to finance national and regional R&D in their own sectors, especially in water, agriculture, ICTs and energy;
6. *Member Countries, without a local productive base with high skilled knowledge, will not be able to compete in, or even move towards the knowledge based economy, as many traditional industries require a technological base.* It is, therefore, important to develop a strategic regional research funding programme with strong linkages to the productive sector. Funding should be given priority when strategic alliances and collaborations are made, and project proposals are directly linked to the promotion of a knowledge economy. Water, renewable energy, pharmaceuticals and agro-food, together with education and capacity building in these strategic spheres, are strategic areas that need funding for research and development;
7. The proposed action will support building the capacity of Member States *to monitor and evaluate performance through STI statistics and indicators.* This will take place through the promotion of evidence-based STI policy-making by fostering the development and utilization of scientific and technological foresight systems. The *Frascati Manual* is a document that contains all the internationally recognized definitions for STI statistics. It should be emphasized that these statistical standards have been the product of a professionalization of statistical data on science and technology and these standards should be used.

UNESCO is committed to supporting developing countries in their pursuit of economic advancement through building their national technological capabilities to harness new opportunities, which will generate jobs and support livelihoods. The set of proposed essential programmes presented in this section have been the product of the many expert group meetings that UNESCO NECTAR has been organizing in the region during the past few years. Utilizing the integrated, 'problem-solving' approach, a multi-objective sustainable development problem has been formulated that comprises the different objectives listed above. The derived solution seeks to facilitate an intensive regional engagement to implement the priority goals and targets towards sustainable development, bringing together governments, the private sector, civil society, the United Nations system and other actors, while mobilizing all available resources.

PROPOSED RECOMMENDATIONS

(UNSG Scientific Advisory Board)

As is clear from the previous section, a number of pre-requisite conditions will need to be achieved at the regional level, before Member Countries can succeed in their endeavours and efforts towards achieving the newly adopted SDGs. It is important, therefore, to consider the institutionalization of these pre-requisite conditions as the main output of the recommended action. To effectively leverage Science, Technology and Innovation (STI) for sustainable development, countries need to be able to adequately deploy the available and appropriate technologies at scale and in a given time frame.

We propose the formation of a new regional non-governmental partnership, which will support the current intergovernmental apparatus led by the League of Arab States (LAS) in mobilizing science, research and technology for development in the Arab region. The proposed partnership will be designed and developed with the following four main pillars. This will ensure the creation of the required conducive environment for fostering real progress towards the optimal use of research results and technological advancements towards achieving the Sustainable Development Goals (SDGs) in the region:

- a. *For STI to live up to its full potential and to be truly transformational*, it needs to be connected to society as a whole, and to translate innovative and creative problem solving approaches from global to national and local levels. To achieve the above successfully, the Arab region needs more regional champions of science and technology as well as regional champions from business, Government and the political arena, society at large and academia, to bring about the aspired positive change towards achieving sustainable development. In the context of the above, we propose the creation of a **UNESCO Arab STI High-Level Advisory Council** (UNESCO ASTI-HLAC), which will work together with the League of Arab States to support the efforts to strengthen the regional STI Governance. This council will also report to the UN High-Level Science Advisory Board on semi-annual basis. UNESCO will select regional experts to serve as council members for 3-4 years. These nominations could be recognized and endorsed by the UN High-Level Scientific Advisory Board;
- b. *For STI to live up to its full potential and to be truly transformational*, the development gap will need to be closed by closing the existing STI investment gap. Ambitious national minimum target investments for STI will have to be set using innovative out-of-the-box financial models. In the context of the above, we propose the creation of a dedicated autonomous fund through large companies ceding a certain percentage of their turnover, which will follow the model of the Moroccan telecom operators. This will be done through the launching of the proposed **UNESCO Programme 'Cents for Education and Development for the Arab Region**

(UNESCO-CEDAR)⁹. UNESCO-CEDAR will encourage all private sector and non-governmental organizations to support its programme through small periodic donations under their social responsibilities budget rather than one large donation, as well as work on raising the awareness of their constituents to accept nominal dues on the sold products such as:

- With telecom operators, to donate, for example, 3-5 cents for each phone call made;
- For the beverage industry, to donate 3-5 cents for each bottle or can of beverage bought;
- For the energy (electricity sector), to donate ½ a cent for each kWh consumed, etc.

It is suggested that the funds received for each country could be then spent at a ratio of 3:2 between national and regional projects and programmes in each specific sector defined by the donor.

- c. *For STI to live up to its full potential and to be truly transformational*, people's knowledge, talent and skills need to be developed and strengthened with a particular focus on their mastering of science, technology, engineering and mathematics (STEM). It is critical to ensure adequate investments in STEM education at all levels. In the context of the above, we propose the development of a regional capacity building Mega-Programme that will support the creation of the required critical mass of experts, scientists, and technical force in strategic spheres; these include water, energy, agro-food, innovative technologies applications and manufacturability through a stronger STEM education;
- d. *To further the enhancement of tertiary and vocational education*, we also propose the development of a regional mechanism for the selection and implementation of Mega-Science regional projects utilizing the funds of the UNESCO-CEDAR programme. Focus will be given to creating educational large-scale pilot systems in selected STI related areas, defined as the national and regional priority areas, to accelerate innovative green technologies transfer and critical mass technical build-up.

The elements of the above partnership comprise the formation of what we can refer to as the **UNESCO Arab STI Facility (UNESCO-ASTIF)**; it will have a Sustainable Development Projects Implementation Unit (SDPIU) associated with it. The following are details of the envisioned facility:

UNESCO-ASTIF Vision: Strengthened Science, Technology and Innovation (STI) systems and policies, nationally and regionally. Regional cooperation in scientific research promoted, and capacities fostered for solving critical challenges to sustainable development in the Arab States.

Mission: Support Arab Countries in mobilizing and committing the required human and financial resources for developing STI and applied research platforms, with stronger participation from the private sector and non-profit organizations towards the successful implementation of projects associated with the achievements of the newly adopted Sustainable Development Goals (SDGs). The Arab STI Facility will provide support in the following areas:

1. Strengthening STI Governance by advocating best practices in building the technological capabilities and industrial base of member states in the Arab Region;
2. Improving capacities of Arab countries and regional organizations to foster the use of Innovative Green Technologies for development;
3. Strengthening the financial base for the science and research platform for better regional collaboration and integration;
4. Building up the necessary national and regional critical mass to ensure quality STI knowledge generation and application towards sustainable development;
5. Developing a conducive environment for innovation, and supporting the best talents through easing the terms of doing business and releasing the forces of competition.
6. Meeting countries' STI needs through preparation of relevant programme and projects that will attract a flow of funds and investments, and piloting innovative technologies and approaches that may lead to their widespread adoption;

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BIOGRAPHY

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