

The Urgent Need for The Introduction & Development of Synthetic Biology in Pakistan

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FOREWORD

Since the conception of Pakistan, our state has seen tumultuous times. In a history rife with unrest, scientific progress was always lacking. Perhaps, apart from agricultural biotechnology, we missed out on the capitalization of most, if not all, major scientific breakthroughs.

However, this need not be the case in future. The purpose of this work, is to take a firm stance for the development of Synthetic Biology (SynBio), The biggest scientific game changer in recent history. SynBio has been under rigorous development since its inception in 2000. This nascent field holds a promise of a chance. A chance to jump back on the train of cutting edge scientific enterprise.

Proper policymaking and implementation of the said policy, can help our country to avail this fortuitous opportunity. This policy paper is an attempt by Team iGEM Peshawar 2016 to implore the government into developing Synthetic Biology in our country.

Team iGEM Peshawar 2016

INTRODUCTION

Since the beginning of the field of Biology, a biologist has merely been an observer. An experimenting observer, with the sole purpose of studying and understanding life. His role was limited to being fascinated with all things created. Synthetic biology upgraded the role of a biologist from an observer of creation to that of a builder; an engineer.

Discounting a few outliers, most life exists in cells, or in combinations of cells. Cells are the basic building blocks of life. They are small microscopic structures consisting of even smaller functionalized particles (like Proteins) that enable a cell to exist and go about its daily routine. Proteins are essentially small molecular robots that can have a lot of different functions, from simpler ones like dragging nutrients from one part of the cell to where they are needed, to the more spectacular ones, like telling a cell when to commit suicide or even produce light!

The cell also has an information core - the nucleus. The nucleus contains DNA, a molecule that stores all the information necessary to build proteins. Proteins are versatile, they are built from information stored in DNA, yet it is also the proteins which are used to build, synthesize and replicate copies of DNA and RNA.

By turning functions of living systems into an engineering notation, synthetic biologists try to treat life like a toolkit, or a programming language. SynBio allows us to make a bacterial cell glow green in response to presence of pollutants, make batteries out of bacteria, or even engineer yogurt producing bacteria to produce extra Vitamin A, while giving yogurt the taste of bananas!

SynBio is taking life to a level akin to that of Legos or playing blocks. The ability to manipulate systems and functions of life, and creating novel rationally designed combinations of these systems by us, is SynBio.

Interestingly, it is not very different from much of the recombinant DNA technology and genetic engineering work that has been going on in laboratories across the nation; in the sense that it utilizes similar chemicals, materials, equipment and even to some extent, expertise. The latter statement alone shows how conducive the environment of our country is to an emerging technology like Synthetic Biology.

In the light of this, investing and promoting this technology will pay off in our country's near future.

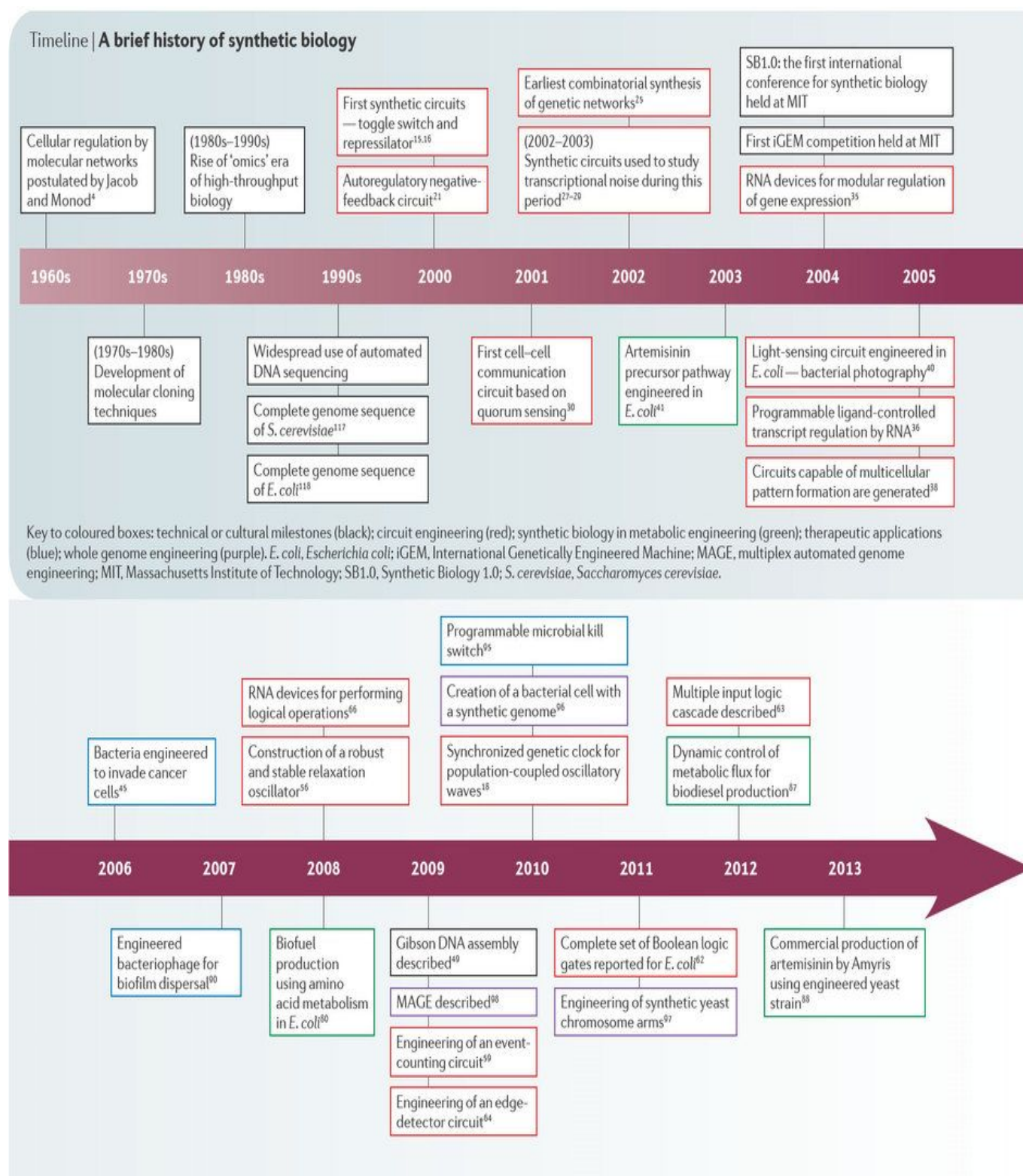


Figure 1: A brief history of Synthetic Biology (Cameron, 2014)

ECONOMIC PERSPECTIVES

According to Allied Market Research, SynBio will be a \$38.7 Billion market globally by 2020. In a few short years. SynBio companies like Biotica and Amyris, both recently signed deals worth \$127 Million and \$100 Million, with GSK and Biofene respectively. The Biotica deal was for each product they would create.

Interestingly, third world economies have the most to gain from these low input-high output deals. Starting now would mean Pakistan would have a good 4 years head start come 2020.

Our nation is well established in the field of agricultural biotechnology and major repurposing of our current facilities will not even be necessary as at the core, both these technologies are built upon the basis of genetic engineering. A slight push in policymaking by the government is all that may very well be needed to kickstart SynBio in Pakistan. The section following this one, will deal with recommendations for this very purpose.

If Pakistan does not set its policymaking apparatus into motion now, we may not develop well enough in time to qualify for a strong position in the emerging global market.

Investment into development of SynBio in Pakistan will be a precedent setting move by a third world country. This will help Pakistan become a third world leader in the field and help our trade and science gain a new dimension of credibility.

The technology of synthetic biology is currently accelerating at four times the rate of Moore's Law. It's been doing that since 2005, and it's likely to continue.

Stewart Brand

RECOMMENDATIONS

Due to the nature of rapidly developing technologies, relevant policies have to be made swiftly to keep up with limited time frames. Using size, impact and timescales involved these recommendations can be broken down into short, medium and long term recommendations. Following is the breakdown-

- Short term recommendations consist of recommendations that have to be implemented within 3 years from the start of policy plan.
- Medium term recommendations consist of recommendations that have to be implemented within 5 years from the end of short term policy period, or a total of 8 years from the start of the policy plan
- Long term recommendations consist of recommendations that have to be implemented within 10 years from the end of medium term policy period, or a total of 18 years from the start of the policy plan. This time period can be significantly removed if interest in the field is garnered.

Short Term

- SynBio public awareness campaigns
- SynBio introduced to college students, in form of text book chapter inclusions
- Creation of SynBio Policy Making Committee (SPMC) charged with developing strategic policies and plans. SPMC will pave the way for the Pakistan SynBio Promotional and Regulatory Office (PSynBioPRO.)
- Creation of SynBio Liaison office that connects the nascent SPMC to international SynBio regulatory bodies abroad, and local biotechnology, ethics and environment protection offices that may have similar frameworks
- Tax rebates and various attractive incentives for universities that offer a HEC accredited SynBio course at Bachelor/Baccalaureate level
- Funded promotion of iGEM in Pakistani educational institutes, also annually fund a single iGEM team from Pakistan
- After this initial round of policy making, Pakistan will be ready for its first SynBio start-ups and businesses

Medium Term

- Inception of Pakistan SynBio Promotional and Regulatory Office (PSynBioPro)

- Dissolution of SynBio Policy Making Committee. The Committee's staff will be a part of the newly formed PSynBioPRO
- SynBio Liaison Office is dissolved into PSynBioPRO
- PSynBioPRO will have a separate wing for overseeing and recording all SynBio research activity of the nation
- Introduction of SynBio at middle school level, with creation of SynBio educational games and mobile applications
- Start a central SynBio start-up accelerator program
- Government funding for Masters and PhD level SynBio research
- Create policies that help small SynBio start-ups survive and thrive in a market full of large SynBio corporations

Long Term

- Introduction of SynBio at primary school level, with the help of blocks and other creative visualization tools
- Create provincial and regional SynBio accelerator programs
- Groundbreaking of Pakistan SynBio Research institute (P-SyBeR)
- Increase the quota of government funded iGEM teams
- Introduce a local variant of iGEM
- Increase funding for SynBio related Masters and PhD level research
- Streamline the SynBio policy making procedure
- Streamline the procedure for approval of commercialization of SynBio Products

CONCERNS

As any new technology is a source of concern, so is SynBio. The biggest cause of concern from SynBio, is arguably the dual use dilemma. As any tool or technology can be used for good or for bad, so is true for SynBio.

Proper policy making, and the implementation of made policies is the best way to ensure the minimization of hazards and risks that may occur from SynBio. Most of these hazards are limited to accidental introduction of lab materials to the outside environment. The actualization of these accidents can be easily minimized.

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