



INSTITUTE OF PHYSICS BELGRADE
National Institute of the Republic of Serbia

IPB STRATEGY AND ACTION PLAN

FORGING WIDER SOCIETAL RELEVANCE THROUGH
RESEARCH, INNOVATION AND EDUCATIONAL EXCELLENCE

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INTRODUCTION

The Institute of Physics Belgrade (IPB) is a research institution with strong national and regional roots. From its inception it has been fully integrated into the international academic community.

IPB was founded with an original mandate to support fundamental research of the highest level in the physical sciences. As the institution has grown in size and relevance its mandate has expanded to include interdisciplinary collaborations specifically targeting intellectual white spaces between disciplines, development and transfer of new technologies and entrepreneurial skills, and the maintaining of key specialized services and infrastructures at the national level.

As a result of this in 2018 IPB became the first national institute of the Republic of Serbia, an institution tasked with the forging of wider societal relevance through research, innovation, and educational excellence.

IPB aims to help shape the future, and in so doing play a visible role in forging Serbia's new global competitiveness. The institution will do this by building on the strengths of its outstanding researchers, talented students and committed staff. The institution will forge and nurture strategic partnerships with the world's leading research centers. It will progress through a balance of careful planning, seizing opportunities, and reacting to emerging needs.

Its scientists and technical staff play an important role in the transfer of knowledge and technology into society and the economy. Through its research, technology, and educational roles IPB serves Serbian society by contributing to its international competitiveness and innovative strength; nurturing creativity, excellence, and the free exchange of ideas; education and training of highly motivated and talented young people with key scientific and technical competencies.

To implement an ambitious program of this kind, an institution needs to realize long-term and effective strategic planning, obtain needed political and financial support, motivate its employees to actively participate in the transformation process.

In the past decade IPB has successfully passed several important milestones related to this process:

- Extensive IPB participation in EU project led to increased researcher mobility, formation of four Centers of excellence defining IPB research priorities and capital investments in IPB research infrastructure. As a result, IPB has become a focal point for the reintegration of key researchers from the Diaspora and the first research institution in Serbia to set up sustainable two-way brain circulation.
- Four-year participation in World Bank project SIP led to the formation of the IPB Innovation Center, IPB's bylaw on intellectual property, its international patent portfolio for Teslagram technology, as well as the implementing of the IPB Strategic plan (2016-2025).

- In 2017 the Government of Serbia agreed to fund building and equipping of Verrocchio Center at IPB as a priority project. In the process, strategic partnerships were signed with CERN, INFN and DESY and IPB's International Advisory Board was formed.
- In 2018 IPB became the first national institute of the Republic of Serbia. IPB's new mission is to forge wider societal relevance through research, innovation and educational excellence.
- In 2019 Serbia became a member state of CERN. IPB leads Serbia's participation in CERN, principally through its ATLAS collaboration. IPB Innovation Center hosts CERN Industrial Liaison Office. The prototype fabrication facility within Verrocchio Center will be hub of IPB's collaboration with CERN in the field of technology development.
- In 2021, the successful external evaluation of IPB by INOMER (France) resulted in the writing of the IPB Transformation plan and its funding through the World Bank project SAIGE which began in 2022. SAIGE is tasked with strengthening IPB organization and technological capacity, principally through technological assistance, technology transfer and infrastructure procurement.
- IPB leads Serbia's research sector in international and national competitive projects (both in research and innovation). In the last few years this has led to substantially increased and diversified overall funding. IPB is host to many Horizon Europe projects including two currently active ERC grants, an EIC Pathfinder grant, a Twinning project and a MSC action.

WIDER CONTEXT

The IPB Strategy and action plan is the result of a long-term transformation process during which several strategic and planning documents were created. The current document is based on ideas, guidelines and goals given in the Strategy on Scientific and Technological Development of the Republic of Serbia for the period 2021-2025, named *Power of Knowledge* ("Official Gazette of RS", No. 10 dated February 10, 2021). Along with the laws related to science and innovation, the Strategy defines the framework for the development of individual institutions, teams and researchers in Serbia, with the aim of creating new knowledge, technologies and jobs. Within this framework, several roles can be recognized as particularly relevant to IPB.

Key roles of science in Serbia

The progress of the Republic of Serbia is not possible without constant access to new scientific knowledge. New products, new industries, and new jobs imply continuous expansion of our knowledge about natural and social processes, as well as the application of that knowledge for practical purposes. Similarly, the defense and security of the state require new knowledge, without which the development of new and improvement of existing systems is not possible. Serbia can achieve access to this key new knowledge exclusively through fostering scientific research.

Serbia's research sector can be of measurable benefit to our society, only on the condition that it is organized into an efficient and truly integrated system based on the scientific excellence of individuals, research teams and institutions; on the relevance of research programs aligned with national priorities; on the efficient monitoring of their realization and application as a basic assumption of their feasibility. In a modern society, this cannot be achieved without robust international cooperation, without free access to the best personnel in the country and abroad, without the strengthening of selected scientific institutions and their transformation into national and regional centers of science and technological development, without the construction and efficient use of competitive scientific infrastructures, without tight integration of scientific research, higher education and economic systems, and, last but not least, without adequate financial support. These are prerequisites without which in the modern world it is no longer possible to ensure the health, prosperity, and safety of citizens.

According to the Strategy on Scientific and Technological Development of the Republic of Serbia, the main strategic goal is for the *scientific, technological and innovation system to contribute to the accelerated development of the Republic of Serbia by improving the quality and efficiency of science, technological development and innovation and the further integration of the system into the European Research Area, thus helping to achieve the standards of developed economies*. To achieve this, the focus of the research should be on several well-defined social challenges and priority technologies, such as health, well-being, defence, security, food, energy, etc. Broadly, one can classify all these research efforts into the following five key areas:

- War against disease
- Defense and security
- Economic well-being
- Educating and informing citizens
- Development of scientific talent

Key societal roles for IPB

Given the role that IPB plays within the overall research and innovation ecosystem of Serbia, the key roles for IPB are those related to:

Development of scientific talent

The responsibility for the creation of new scientific knowledge, as well as for most of its applications, rests with a small number of citizens who understand natural laws and social processes and who are skilled in the techniques of scientific research. The speed of our progress at any frontier of human knowledge, as well as the speed of practical implementation of that knowledge for the generation of economic and wider social benefits, all depend to the greatest extent on the number of highly qualified and trained scientists, engineers, and other experts at our disposal.

Training scientists is a long and expensive process. There are enough talented individuals, but fewer and fewer of them decide to pursue a career in science - not enough to make a substantial step towards a knowledge-based society. It is necessary for all relevant institutions to actively promote a career in science, but also basic virtues without which not only the improvement of science but of the entire society is not possible - virtues such as work habits, perseverance, curiosity, creativity, and confidence in one's own abilities. Positive effects cannot be achieved in a society where evaluation is not based on quality. Key institutions such as IPB should, by their actions, explain to the public the transformative character and positive social role of science. Investing in the development of scientific talent has positive effects on other segments of society that need talented and dedicated personnel.

In the case of Serbia, one must take into consideration negative demographic trends (declining birth rate and the resulting declining working population), and the necessity for substantially increasing the added value per employee (improving human resources and the introduction of high technologies).

Educating, informing, and motivating citizens

Educated, informed, and motivated citizens are a prerequisite of modern, developed societies. In today's world, science and technology play pivotal roles effecting all aspects of society from economy to security, from media to decision-making. As first National institute

of Serbia, one of the key aspects of IPB's wider societal relevance is the maintaining of a robust communication and outreach program aimed at all citizens (e.g., decision-makers; members of the media; people interested in science, innovation and education; students; IPB partners and employees). Specific roles are to: present IPB as a modern, research institution creating and applying new knowledge and ideas; presenting key results and methods used; presenting IPB ideas and values; cultivating the culture of science and fostering creativity; motivating young people to pursue careers in science; strengthening scientific journalism in Serbia; promoting fact-based, rational decision-making.

Economic well-being

One of the key goals of any healthy society is high employment. This goal can only be achieved through a long-term process of encouraging and effectively using the creative ability and working capacity of the entire citizenry. To achieve this, we must make many new and globally competitive products. For this we will need new and strong companies. Those new products and processes arise from new principles and concepts, and these arise from basic scientific research. Basic scientific research represents scientific capital. Serbia can no longer allow itself to be dependent on America or Europe (or soon on the Far East) as the main sources of available scientific capital. A greater volume and quality of domestic scientific research is essential for achieving the goal of high employment.

How can IPB help to increase this scientific capital? First, it must produce and scientifically educate enough citizens, because both the new knowledge that is generated and the successful application of that knowledge for practical purposes rest on them. Second, IPB as a key center of basic research must itself be strengthened. IPB also needs to play an active role in strengthening other research centers. As places that are under relatively less pressure to produce immediate, tangible results, these institutions provide the environments most conducive to the creation of new scientific knowledge. With few exceptions, most research conducted outside these institutions involves the application of existing scientific knowledge to practical problems. The creation of new knowledge today is not evenly distributed in scientific research organizations.

For science to serve as a powerful factor in securing wider social benefits, applied research must be encouraged and visibly strengthened. In order to improve the quality of scientific research, steps must be taken to modify the procedures of education and practical training; procedures for identifying, recruiting and employing the greatest scientific talents; procedures for promotion, categorization and payment of scientific personnel. Here too IPB, as first National institute of Serbia, needs to play an important role.

IPB can encourage the scope and quality of research and increase the degree of its application to the economy: through increased flow and application of new scientific knowledge, by assisting in the process of developing key scientific and engineering talent, by working with government and industry in finding practical modalities for efficient transfer of new knowledge from research and development centers to the economy.

Defense and security

Bitter experiences from the recent past tell us that the issues of defense and security of small countries like Serbia are not things of the past, that it is important to build intertwined networks of alliances and partnerships, but that it is even more important to rely on one's own strengths, capacities and creativity. The processes of globalization and European integration are fundamentally and rapidly changing the nature of relations between states and peoples.

Societies that successfully adapt to these changes, that grow stronger in these conditions, are dynamic societies that have something to contribute to global society and their neighbors in the economic, scientific, and cultural sense. In this sense, our knowledge is a basic prerequisite for the successful defense and security of society.

In times of war, for security reasons, the contributions of domestic science to the defense of the country are not publicly highlighted. Citizens are nevertheless well-aware of those contributions, although not of the names of the deserving scientists, engineers, and institutions. It is necessary to enable those experts to continue making part of those contributions to national security even in peace. Military research in peacetime represents an important pivot of the economy and a flywheel for positive changes in many other industrial branches.

Additional aspects of security related to IPB expertise are in cyber security, food security, security in case of climate change and natural disasters, risk assessment and adaptation.

DIAGNOSIS

Measure of excellence

According to all national performance indicators, the Ministry of Science, Innovation and Technological Development, recognizes IPB as one of the best research institutions in Serbia. This is the reason why five years ago it accredited IPB as Serbia's first national institute.

Serbia is a small country with a relatively small research population. As a result of this, only a small number of research centers in Serbia and the region are truly competitive in the global arena. IPB is one of the leaders in this regard.

In terms of size, IPB makes up only about 1% of the research community in Serbia, but in terms of the number of papers and citations in leading scientific journals, IPB provides about 10% of the country's scientific output.

We put before ourselves a substantially higher goal – that of making IPB research effort comparable to that of world-class research institutions not only by bibliometric and other quantitative measures, but also by the visible and positive impact of its research effort on science and society. This is the goal of the current strategic process. To do this IPB needs to develop corresponding extended performance metrics, as well as a set of moving goals to guide the institution towards the realization of its ambitious goals.

Technological capacity

IPB maintains a competitive research infrastructure in its four centers of excellence within which it conducts roughly 75% of its research. To a good approximation, these centers of excellence determine IPB's research priorities. IPB is one of a very small number institutions in Serbia's research sector in that it possesses technological workshops, viable spin-off companies and an Innovation Center coordinating innovation and commercialization activities. Taken as a whole, however, the system is still not functioning optimally.

Substantial increase of IPB technological capacity and competitiveness hinges on procuring necessary funds for new equipment and workshop space, on training technical staff and on producing the first batch of success stories that will motivate more researchers, engineers, and technicians to take active part in innovation and commercialization activities. Used efficiently, funds from existing capital investments such as Verrocchio and SAIGE have the capacity to realize this process.

Critical size

With 125 senior researchers, 75 doctoral students, 20 technicians, 30 administrative staff and 50 engineers employed in its spin-off companies, IPB is one of the largest research institutions in Serbia, and the largest one in the physical sciences.

While large in the context of Serbia, IPB is relatively small as compared to its global competition, particularly those institutions covering a research area of similar scope. In that sense one can probably best characterize IPB as being (slightly) below critical size needed to be globally competitive. An educated guess of the required critical mass for a similar type of institution would be somewhere between 300 to 500 researchers.

Taking into consideration the available real estate, the acknowledged need of the country to finance an expansion of its research base, the capacity of the higher education system in Serbia to realize this expansion, as well as the limited financial resources available, it is not unreasonable to conclude that within the next ten years IPB could attain the stated critical size.

Research focus and coherence

The research conducted at IPB is mostly basic science research covering a wide area within physics and material science. However, this research effort is fragmented and lacks coherence. Different areas of IPB research show different levels of competitiveness when compared to global state of the art.

Among other reasons, this situation is a consequence of a lack of precisely defined national tasks that would be set before IPB. Although the Ministry has a consistent long-term strategy and effective instruments for the development of science in Serbia, consistent sets of priorities or effective policies for stimulating excellence, creativity, and social relevance are not set for individual institutions.

There are many downsides to operating without a such institution-specific missions. An upside is that researchers in Serbia have a substantial amount of freedom in choosing the focus of their work – more so than in many other places. By itself this could lead to a dynamic research environment.

The correct way to build an institution-specific mission is to first determine potential ecological niches that best use the specific strengths of each institution (or the weaknesses of its competition). To achieve and sustain excellence and competitiveness, IPB research must be extremely well integrated into the global research effort. Most of its expertise must necessarily be focused on a relatively small number of well-defined priority areas, within which it can visibly contribute to that wider effort.

Focus and networking are the basis of wider societal relevance of IPB research. In addition, IPB priority areas must nurture strong ties to selected in-house capability hubs as a basis of viable multidisciplinary (e.g., hubs for microbiology, artificial intelligence, sensing technologies related to conservation of cultural heritage).

From incremental to ground-breaking research

In Serbia, new fields of research are rarely opened. In addition, primarily due to the relatively small size of its research community, a major part of current research effort can be

characterized more as incremental in already well-established fields and less as ground-breaking. It is imperative that IPB encourages, motivates, and stimulates its researchers to venture into new and risky but fruitful research fields.

Applied research and innovation

IPB need to become better at innovation because practical tasks are an important motivator for new ideas. One could defend the position that in today's world science is too much driven by innovation, but in Serbia it is not driven enough.

In Serbia, applied research is still seen as inferior to basic research. The reason for this is that applied research is not driven and financed by industry; rather it has evolved into an ecological niche in which sometimes less competitive researchers thrive. The great majority of researchers believe that participating in innovation would somehow decrease the quality of their research.

It is necessary to show examples where the success in innovation did not lead to fall of quality of basic research.

Key growth happens when you are the first to identify and pounce on the “next big thing”. To succeed in that you must be good at identifying it before others, you must have the power to act speedily and decisively, your organization has to have the needed resources and flexibility to implement the action. If you are lacking any or of these things, then your first step is to acquire them and then to wait for the next opportunity to present itself.

In most cases we are not capable of being competitive in pouncing on the next big thing. If it is a truly important thing, then big sharks will come and smell the blood and push us out. We must make transformational changes to be successful. Those we can make if we build on our relative strengths or on the relative weaknesses of others.

Innovation and education as paths to societal relevance

Social relevance is a key aspect of creating a new IPB. There are many levels of such relevance that IPB can address – relevance to Serbia, relevance to the region, relevance to Europe, global relevance. The dominant ways we can contribute is through excellent research, cutting innovation, and education focused on creativity.

All three areas are in crisis in the world and in Serbia. There have never been so many scientists, yet there are fewer transformational breakthroughs than before. A possible reason for this is that science has become a profession more than a calling or a passion. Another is that technological success (particularly short-term success) has been driving science. A third is that with the increase of number of scientists there seems that has come a decrease in their quality. This parallels the key problem in education. In science education we focus more on specialists than on generalists, more on craft than on creativity.

The world needs a new education paradigm that can effectively tap human creativity in large numbers. This task is associated with education, and education is a very inert system. It is

more inert in places where successful institutions of top quality have existed for a long time – the very nature of their success makes it difficult for them to change, because to take the next step they would first need to get rid of something, to take a step back. There are advantages to coming in late in the game.

IPB researchers acknowledge the wider and multi-faceted educational aspect of their research effort. They see this as a necessary investment in the future and their own careers. At the same time, IPB researchers still do not have a clear framework for recognizing the need for forming a coherent graduate program and specialized multi-disciplinary training programs.

Creativity boost

Human creativity is Man's principle cultural and economic resource. Identifying, nurturing and catalyzing creativity are of central importance. For this reason, it is also ultimately the most profitable and socially relevant endeavor. We operate under the belief that we currently tap only a very small part of the potential creativity of individuals and groups, a latent creativity that is uniformly distributed across humanity and needs to be actuated.

The most important task then is to determine ways to identify, stimulate and challenge creativity more efficiently. Our principal fields of expertise are in physics and the related technologies. It is natural then to dominantly target creativity in these fields. At the same time, one must take into consideration that new areas of creativity often appear on the boundaries of established disciplines.

Because of this, while keeping our primary focus fixed, we need to somewhat widen it to incorporate other sciences (e.g., astronomy, biology, psychology, sociology, economics), as well as other disciplines in which creativity plays a central role (e.g., music, painting, literature, architecture).

Whatever field we are in, our principal tasks are not the individual acts of creativity but the techniques to efficiently realize potential creativity, to mass produce it. If we identify ways to do this, or even of slightly increasing the possibility of realizing this kind of potential, we will have put in place a truly transformative process.

Partnerships and collaborations

Partnerships and collaborations with other institutions are crucial for advancing the research goals of IPB. By working together with other institutions, we can leverage expertise, share resources, and access new opportunities to advance our research.

IPB have established partnerships with several foreign and domestic institutions that share similar research interests and goals. IPB's foreign partners include CERN, the Italian National Institute for Nuclear Physics (INFN), and the German Electron Synchrotron (DESY). In addition to foreign partners, IPB also have strong partnerships with domestic educational institutions but also companies. Principal among these are partnerships with the Faculty of Sciences at the University of Novi Sad, the Faculty of Mechanical Engineering at the University of

Belgrade, the Institute for Comparative Law, and industrial cooperation with UNIOR Components from Kragujevac.

These partnerships provide opportunities for us to collaborate on research projects, share resources, and access new technologies and expertise.

Organization commensurate to IPB's expanded role

IPB is already a complex organization consisting of a non-profit research core, of for-profit technological spin-off companies, of specialized organizational units (e.g., Innovation center, Center for analysis and development, Verrocchio center), and a staff of engineers, technicians and administrative personnel. The level of organizational complexity has increased with IPB's expanded role as Serbia's first National institute, and will further increase in the future, particularly with the start of operation of Verrocchio center and the planned substantial increase in the number of researchers, engineers and technicians employed.

To function efficiently, IPB's organizational and decision-making structures need to adapt to this new complexity, operating more like an enterprise than a typical research department. IPB has already made key steps in this process in the past few years (now substantially speeded up through the SAIGE project). This includes the establishing of an Office of Director at the top of the decision-making hierarchy (currently consisting of Director, Chief-of-Staff, Deputy Director for Research, Deputy Director for Innovation and Commercialization, and Legal Counsel). IPB has reorganized its administrative staff, hiring key individuals with specialized skills (e.g., communication, internal audit, strategic planning, capital investments, project management). Existing staff members have received additional training for new positions (e.g., human resources, public procurement). Both processes are planned to continue in the next few years.

Financing commensurate to IPB's expanded role

IPB is financed through **institutional funding** (6 M Euro in 2022), **national and international competitive projects** (2 M Euro in 2022), and **other sources** (e.g., specialized services) that currently negligibly contribute to the total budget.

IPB also gets additional funding from **strategic projects/investments** (Verrocchio, SAIGE). SAIGE funding is geared towards realizing (in the following ten years) the **IPB Transformation plan**, whose principal aim is to **increase and diversify annual funding** to levels commensurate with IPB's expanded role and guaranteeing long-term sustainability. **The goal of the IPB Transformation plan is to ultimately attract roughly similar levels of financing from budget (institutional funding), competitive projects, and commercialization.**

In addition, IPB is actively working at attracting further capital investments, preparing detailed project documentation for a diverse portfolio of investments in IPB and its infrastructure.

GUIDING POLICY

GP1. Make IPB research effort globally competitive; Utilize existing strengths and opportunities, mitigate identified weaknesses and threats

We aim for IPB to become a world-class center for advanced sciences and technology, recognized internationally as an institution that imagines and influences the future. Such an institution must put excellence at the forefront. At the same time, IPB needs to be strongly integrated into the global effort, to establish and nurture a reputation of a global partner of choice in specific areas of research, innovation and education that are at its focus.

Many things can (and should be) planned for, other processes open-up rapidly and often unexpectedly. To benefit from the former, an institution must put in place an ongoing system of analysis and planning (Center for analysis and development). To seize upon the latter types of opportunities, IPB must put in place a decision-making system (Office of the Director, special consultants) with built-in speed and flexibility needed to identify and successfully pounce on them.

Specifically:

- Focus on research excellence, stimulate high impact research
- Expand cooperation with global leaders in relevant fields; Create strategic partnerships
- Grow and maintain a competitive research infrastructure
- Create niches of competency, increase coherence, build in flexibility
- Incorporate key areas of multidisciplinary to strengthen quality and impact

GP2. Attract and hire the best people, train them, and help them develop through their career; An exceptional research institution has the best researcher, best students, best staff, best management, it inspires others

Specifically:

- Attain critical numbers of researchers and staff, hire the best experts
- Maintain intense two-way mobility of researchers and staff
- Actively work at training and developing people throughout their careers

GP3. Create and maintain environment conducive to the creativity of individuals and groups, broad enough to encompass evolving employee interests

Creativity is most often associated with individuality, diversity of approaches, skills, and motivations. Teamwork, on the other hand, requires a commonality of effort, values, and a desire to work with others and to value their contributions. The ideal environment balances between these two, as it balances between competition and collaboration.

Specifically:

- Though difficult to quantify or document, the maintaining of this kind of an environment is more important than more easily measurable performance indicators
- A truly creative environment blurs the difference between work and play
- Employees need to feel safe and free to contribute, share the values and belong to an institution that stimulates them, allows them to develop and grow

GP4. Generate wider societal benefit through leveraging IPB knowhow and expertise

Specifically:

- Create and help commercialize new technologies to enhance Serbia's economic development
- Attain and expand social relevance of institution in Serbia and the region
- Improve people's lives through preeminent research, education, and creative endeavor
- Actively communicate with the wider public about research, innovation, and education on how these fields are relevant for modern society, and how IPB contributes to the global effort

GP5. Establish a sound financial and organizational basis for sustainable operations and growth

Specifically:

- Set up and maintain efficient and flexible organization and management
- Expand and diversify funding (institutional funding, competitive projects, commercialization)
- Attract strategic projects and capital investments

COHERENT ACTIONS

Flowing out of the above Guiding Policies we have the following Coherent Actions and their corresponding specific action steps.

Actions flowing from Guiding Policy 1:

Make IPB research effort globally competitive; Utilize existing strengths and opportunities, mitigate identified weaknesses and threats.

A1. Grow and maintain excellence and competitiveness of research and innovation

- A1.1: Monitor and analyze performance via relevant KPI's (Key Performance Indicators)
- A1.2: Encourage and train researchers to successfully publish in highest impact journals, apply for and get prestigious projects
- A1.3: Determine criteria for, identify, and stimulate ground-breaking research
- A1.4: Compare IPB performance to that of global leaders, suggest possible changes in the IPB monitoring methodology

A2. Grow and maintain a competitive research and technological infrastructure

- A2.1: Monitor and analyze implementation via relevant KPI's
- A2.2: Conduct internal assessments of the state of the infrastructure, its use, and future needs
- A2.3: Plan and implement capital investments and upgrades of infrastructure

A3. Create niches of competency, increase coherence and flexibility, create multidisciplinary hubs

- A3.1: Reorganize IPB research units to focus research effort, increase coherence, create multidisciplinary hubs. Identify and open new research topics and directions
- A3.2: Conduct internal assessments of the performance of research units

Actions flowing from Guiding Policy 2:

Attract and hire the best people, train them, and help them develop through their career; An exceptional research institution has the best researcher, best students, best staff, best management, it inspires others.

A4. Increase number of researchers and staff to attain critical numbers, hiring only the best talent

- A4.1: Determine the critical numbers of researchers and staff for IPB, strategies and procedures of how to attain these numbers without compromising quality
- A4.2: Monitor and analyze changes in numbers and performance of researchers and staff, note key sources and sinks of best talent
- A4.3: Determine strategies for expanding “feed-in zones” from which IPB draws its best talent

A5. Maintain and further increase intense mobility of researchers and staff

- A5.1: Monitor and analyze mobility and support mobilities of special interest to IPB as a whole via relevant KPI's
- A5.2: Compare IPB mobility to that of global leaders, suggest possible ways to stimulate certain types of mobility of special interest to IPB

A6. Training of researchers and staff for career development

- A6.1: Create a new organizational unit dedicated to professional training of researchers and staff
- A6.2: Create possible career development plans and corresponding KPI's
- A6.3: Track and analyze careers of researchers and staff and alumni
- A6.4: Implement career developments of special interest to IPB

Actions flowing from Guiding Policy 3:

Create and maintain environment conducive to the creativity of individuals and groups, broad enough to encompass evolving employee interests

A7. Create and maintain a creative and stimulating work environment open to evolving employee interests

A7.1: Determine key quantitative indicators of a creative and stimulating work environment and implement accordingly

Actions flowing from Guiding Policy 4:

Generate wider societal benefit through leveraging IPB knowhow and expertise

A8. Generate wider societal benefit

A8.1: Further expand and analyze all potential areas of societal benefit open to IPB (economic and all other benefits). Determine how best to support these efforts

A8.2: Create and commercialize new technologies to enhance Serbia's economic development

A8.3: Work with other institutions interested in expanding social relevance to Serbia and the region

Actions flowing from Guiding Policy 5:

Establish a sound financial and organizational basis for sustainable operations and growth

A9. Establish an efficient organizational basis for IPB's expanding roles

- A9.1: Set up and maintain efficient and flexible organization and management
- A9.2: Procure and implement key software platforms such as Idea Management System (IMS), Enterprise Resource Planning (ERP), Customer Resource Management (CRM), Document Management System (DMS)

A10. Expand and diversify funding

- A10.1: Devise plans to expand and diversify funding, determine relevant KPI's and milestones
- A10.2: Broaden effort on national and international competitive projects
- A10.3: Fundamentally increase revenues from commercialization
- A10.4: Attract new strategic projects and capital investments

MISCELLANEOUS

The previous sections represent the core of a good strategy. This core leaves out such things as principles and visions, values, hierarchies of goals and objectives, references to time span or scope (with the obvious exception of those related to the action plan and the corresponding performance indicators). All of these may be present in each strategy, but only as supporting players.

This section deals with some of the supporting player. The section also gives a historic relation of the present document to IPB's previous Strategic plan, as well as to the Transformation plan that is the basis of IPB's strategic strengthening process within the SAIGE project of the World Bank.

SWOT analysis

Strengths

IPB is Serbia's first national institute. Four of its research units are centers of excellence, the largest concentration of centers of excellence in the region. The aforementioned centers of excellence represent a key part of IPB's overall research effort, an effort well profiled in relation to European and national research and development priorities. In the previous period, the scientific infrastructure of the Institute was essentially strengthened from European and national sources. A substantial part of the researchers at the IPB were educated and worked in the world's leading research centers.

Weaknesses

IPB research is still not sufficiently integrated into larger coherent units and connected with the realization of strategic goals relevant to society. There is limited communication between researchers (and institutions). Part of the scientific infrastructure of the Institute is not yet competitive at the top world level. There are still certain administrative, organizational and personnel deficiencies that hinder high-quality scientific work and reduce the institution's financial absorption power.

Opportunities

Serbia has a high-quality and numerous scientific and technological diaspora in several priority research and development areas of interest to the Institute. This diaspora provides a connection with top world institutions and a basis for the reintegration of key experts and expertise. Also, the leading institutions in Serbia have access to personnel in a wider linguistic and cultural space. Allocations for science are on the

rise (increase in the total budget, obligations of the state in the EU accession process). New legal frameworks have established more favorable financial instruments (institutional funding, funds for science and innovation), as well as (expected) special lines of funding for institutes of national importance. Serbia became a full member of CERN. Political stability, economic growth (especially in the high-tech sector) and increased mobility of researchers within the scope of work on European projects and collaborations are beginning to give (first) positive results in curbing the brain drain in key areas.

Threats

Insufficient number of researchers in Serbia (half of the European average), aging of the research population and insufficient number of top researchers of the middle and younger generation. In order to be a top institution in the European framework, the Institute must be even more successful in the permanent action of identifying and hiring key experts from the diaspora, regions and other countries. The brain drain continues, which visibly affects the quality of young researchers available to even the best domestic institutions. In the general public, there is still not enough support and understanding for the process of creating a globally competitive scientific and high-tech sector. For many, the ambitious science and development policy is still only a declarative national interest of the country. The newly started process of strengthening competitive institutions can lead to great resistance from the less competitive part of the scientific community.

Mission, vision, strategic objectives

At IPB we believe that modern research centers share a common mission to solve society's greatest challenges and answer its enduring questions. Each institution brings its unique assets and experiences to that task. To be successful, IPB's Strategic planning process demands from us that we identify, appreciate and strengthen those key positive aspects of our institution that distinguish it from all others.

IPB tries to actively promote an atmosphere of an ambitious institution made up of ambitious individuals working towards a set of common, challenging, and socially worthwhile goals. In the realization of these goals IPB does not put any upper limits on the possibilities offered to its researchers, students, and staff.

IPB Mission: Improve people's lives through preeminent research, education and creative endeavor.

IPB Vision: Aspire to become recognized internationally as an institution that imagines and influences the future.

We put before ourselves the overarching objective to become a world-class center for advanced sciences and technology, and to achieve this in the next ten years by realizing the following four strategic objectives:

- Create and help commercialize new technologies to enhance Serbia’s economic development.
- Establish and nurture a reputation of a global partner of choice in selected areas of R&D.
- Generate wider societal benefit for Serbia and the region through leveraging IPB knowhow and expertise.
- Establish a sound financial and organizational basis for operations and sustainability.

Shared values

In 2013 IPB implemented a detailed and public procedure for collecting and analyzing data related to the formulation of a set of basic values that are common to IPB. The procedure concluded that we agree on the following seven values that we share and want to define us in the future:

- We believe in the transformative power of ideas and intellect.
- We foster a community built on intellectual freedom, security, and respect.
- We honor our predecessors and work to leave an enduring legacy for those that follow.
- We strive for excellence in all that we do and all that we produce.
- We promote accountability, transparency, and effective stewardship.
- We act with integrity and responsibility.
- We seek a partnership role in how Serbia transforms its society and economy.

Measuring the societal value of research

The societal added value of the research, education and innovation conducted at IPB represent the very core of our institutional mission. During the past several years IPB has focused on developing a set of appropriate metrics with which it would be possible to continuously monitor and assess the impact of an institutions research effort on Serbian society. We believe that this kind of monitoring has the power to positively impact the research and innovation sector in Serbia.

Preliminary results of this effort were submitted to both the professional and wider public in 2014 as a basis for setting up national consensus related to the future roles of science, higher education, and technology development in Serbia. To do this IPB organized the Future of Science in Serbia forum and presented the so-called “Ten Commandments” – ten general theses intended to serve as a basis for the setting up of a national consensus related to the

benefits that Serbian society has (and should have) from its science and technology sector. These theses represent the first step in the process of developing metrics to gauge this type of societal utility.

Theses for national consensus

1. **Expansion of scientific knowledge represents one of the most powerful transforming forces in society.** It affects us all: through the power of newly generated ideas, through the revealed diversity and beauty of the world around us, through the ability to inspire us to further examine the limits of human creativity, through new technologies that give us the tools to change the world.
2. **The domestic expertise, knowledge and competencies of a nation are its principal resource.** For decisions to be made successfully and correctly, a country must have at its disposal adequate numbers of domestic experts in key fields, such as: food safety, disease prevention, energy efficiency, nuclear safety, etc.
3. **Science and the technologies it brings forth are the key elements of economic development.** Only a relatively small part of a country's population works in science and technology. Nevertheless, even in the conditions of limited available funds, profit from this sector has the fastest transfer to wider society through sale of high-tech products, services, intellectual property, as well as the resulting added value to the wider economy.
4. **Rational, fact-based discourse and the culture of science represent global civilizational values that Serbia shares.** More than four centuries of continuous scientific and technological progress have led to the rapid development of mankind. All the achievements of that progress are at our disposal, but they also bind us.
5. **Science is the foundation of the educational system of a country and an inspiration to its citizens.** Science is an exciting and challenging adventure of the human spirit that nurtures the knowledge, abilities, work habits and values needed to get us out of crisis. It is both a set of knowledge and a method of generating new knowledge. As such, science is the foundation of education at all levels.
6. **Science is a key precondition of a secure society.** Security issues, of state and individuals, are inextricably linked to our ability to rationally perceive and understand our environment. The world and society in which we live are becoming more and more complex, and the role of science is becoming more and more important.
7. **Science is the prerequisite for citizen's health and welfare.** A prosperous society rests on the health and well-being of its citizens, on access to energy, healthy food, clean water, and quality education. Competitiveness, especially in the physical and biomedical sciences and their associated technologies, is crucial to realizing these needs.
8. **R&D is one of a small number of sectors in Serbia whose performance and competitiveness is gauged according to established international criteria.** Although insufficiently funded, Serbian science shows a visible (and for some unexpected) increase in the level of international competitiveness. If it manages to include the

creative capacity of both local experts and its numerous scientific diaspora, science has the potential to stimulate a wider national revival.

9. **Past successes of Serbia's renowned scientists represent an important facet of its national identity.** We are rightfully proud of the achievements of great men such as Nikola Tesla, Mihailo Pupin, and Milutin Milanković. Their successes are a source of national pride and lead to an increase in the future ambitions of both citizens and the entire country.
10. **Countries do not invest in research because they are rich, but to enhance the levels of their development, influence, and wealth.** Let us learn from the successes of others. The number of countries, both large and small, which in the past successfully used moments of scientific breakthroughs to make visible strides in their development, to become globally competitive and prosperous in the space of a single generation, is not negligible.

Strategic plan for IPB for 2016-2025

In its first five decades IPB grew into a research leader in Serbia and the surrounding region. We took pride in this accomplishment, yet we shared the belief that we are capable of so much more. Too often, past achievements emerged from ad hoc alliances and individual initiatives.

For this reason, we began a new era for our institution with the forging of a Strategic Plan for IPB for 2016-2025 that sought to: (1) harness all our strengths in a coordinated way, (2) transform IPB into a globally recognized center of research and innovation, (3) restructure the institution to run like an enterprise.

Three years before the writing of this document IPB participated in a wide-ranging process designed to develop an overarching plan for the institution. Key help in realizing this came through the Serbia Innovation Project, a project funded by the EU on behalf of the Serbian Government and implemented by the World Bank. The joint effort involved many of our stakeholders, external experts, our alumni, students, researchers and staff, all sharing marked enthusiasm for the future of IPB as a research and innovation leader.

Principle decisions were made on the basis of a detailed analysis of the responses to our stakeholder questionnaire sent out to more than 20 thousand individual addresses in order to gather opinions concerning Serbian R&D from a wide network of interested parties that included: representatives of the Serbian Government, of regions and local municipalities; members of the business community, of the research and education sector, of the army and defense industry, of the diaspora; members of the academy; representatives of R&D institutions; relevant NGO's, the media, and individual citizens. An important additional goal of the whole process was to initiate a comprehensive social dialogue regarding the type of R&D sector the country needs and wishes to build.

The resulting Strategic Plan for IPB for 2016-2025 was the result of the joint effort of IPB management, colleagues from our Strategic Growth Unit and Innovation Center, as well as of

a team of experts from the World Bank. The document presented precise details on where we need to focus our considerable talents, the progress we expected to achieve, and the key performance indicators needed to track this progress.

From Transformation plan to a new Strategy and action plan

In 2021 IPB implemented a self-evaluation, and later an external evaluation of the institution implemented by INOMER (France). As a result of this IPB and the World Bank developed the ten-year IPB Transformation plan which became the basis of an institutional strengthening process within the SAIGE strategic project of the World Bank. The project started in 2022 with the signing of corresponding documents between IPB, Ministry of Education, Science and Technological Development, and the SAIGE project implementation unit. The first phase of the project lasts four years and consists of financial and expert help related to technical assistance, technology transfer, and infrastructure procurement.

The following make up the key elements of IPB's ten-year Transformation plan:

Transformation vision

IPB's goal for the next ten years (2022-2031) is to become a regional leader and recognized center of excellence. To achieve this the Institute will continue to develop its effort in basic science, substantially strengthening efforts in the fields of education and training, on the one hand, and innovation and commercialization, on the other.

Three key pillars making this possible can already be found in IPB's Innovation Center, Center for Analysis and Development and Verrocchio Center. During this process, IPB will transform through active involvement in Serbian and European research and innovation ecosystems. The expanded roles require straightening organizational capacities and access to needed funds. The former is being handled through long-term capacity building supported by the World Bank, the latter from further enhancing the capacities for attracting new public and private funds and direct commercialization of the results of applied research. In this way IPB will be transformed into a leading partner in national and European projects, will become a focal point for reintegration of experts from diaspora and will in this and other ways significantly support socio-economic development of Serbia and the region.

Transformation principles

- The management and governance teams of IPB are highly committed to transform IPB into an impactful institute and are dedicated to lead the change proactively and collectively.
- Transformation is only possible with the active engagement and participation of IPB staff at all levels. Thus, the transformation of IPB puts the staff at the center of the change process and ensures direct and clear communication at each step of the journey.

- The transformation vision is the ultimate target to be achieved in 10 years through rigorous implementation of the plan outlined in this document.
- A complete transformation is not possible without improvement of the Serbian R&D and innovation policy and legislative framework. Therefore, IPB leadership will proactively work with Ministry in charge of research and innovation to create a national framework conducive to change and supportive of growth similar to the EU.
- Considering the interdependence between Research and Development Institute (RDI) performance and the performance of the Serbian R&D and innovation ecosystem, for successful transformation, IPB will proactively invest in strengthening its linkages with all types of stakeholders in the ecosystem from the start of the process. In this process, close collaboration, and communication with the other RDIs that are implementing their transformation plans will be particularly important and be given high priority.
- A successful transformation requires sufficient resources. To this end, IPB leadership will ensure that sufficient level of funds is raised from national and international sources, and the existing resources of the institute are used effectively and efficiently to implement this plan.
- Resources provided by the Ministry from the World Bank funded 'Serbia Accelerating Innovation and Growth Entrepreneurship' (SAIGE) project will be used effectively to ensure that the transformation leads to desired results and IPB achieves its transformation vision.

New Strategy and action plan

The external evaluation of IPB came five years after the start of the Strategic plan for IPB for 2016-2025. The consensus of the international evaluation team was that by all key performance indicators of that document IPB found itself at the mid-point of its stated ten-year goals, i.e., that the first five years went precisely according to the Strategic plan.

The start of the SAIGE project was deemed to be an excellent opportunity to implement a new Strategy and action plan for IPB that would build into it the reinforcing components to be implemented through the SAIGE process. Like the Transformation plan itself, the new Strategy and action plan was given a ten-year time scale.

The new strategic document necessarily shares much of its basic structure with the previous strategy, but it builds into it three key additions that have happened since that strategy was delivered, all of which have the capacity to profoundly positively impact IPB strategic plans:

- IPB became the first National institute of Serbia.
- The Government of Serbia agreed to fund the construction and equipping of the Verrocchio Center at IPB as a priority project.
- The IPB transformation and reinforcement process started (funded through SAIGE).

EMPLOYED METHODOLOGY

The core structure of the current strategic document relies heavily on the book “Good Strategy / Bad Strategy” written by Richard Rumelt. All the quotations in this section are from this book.

“Bad strategy is long on goals and short on policy or action. It assumes that goals are all you need. It puts forward strategic objectives that are incoherent and, sometimes, totally impracticable. It uses high-sounding words and phrases to hide these failings. Bad strategy is vacuous and superficial, has internal contradictions, and doesn’t define or address the problem. Bad strategy generates a feeling of dull annoyance when you have to listen to it or read it.”

“A good strategy defines a critical challenge. What is more, it builds a bridge between that challenge and action, between desire and immediate objectives that lie within grasp. Thus, the objectives a good strategy sets should stand a good chance of being accomplished, given existing resources and competence. Good strategy and good organization lie in specializing on the right activities and imposing only the essential amount of coordination.”

Following Rumelt, the core of the IPB Strategy and action plan consists of the following three sections: Diagnosis, Guiding policy, and Coherent actions. The core leaves out such things as principles and visions, values, hierarchies of goals and objectives, references to time span or scope (with the obvious exception of those related to the action plan and the corresponding performance indicators). All of these may be present in any given strategy, but only as supporting players (in the current document they are relegated to the Miscellaneous section).

Diagnosis

“A diagnosis defines or explains the nature of the challenge. A good diagnosis simplifies the overwhelming complexity of reality by identifying certain aspects of the situation as critical.”

“Diagnosis is a judgment about the meanings of facts and educated guess about what is going on – especially about what is critically important. The diagnosis should replace the overwhelming complexity of reality with a simpler story, a story that calls attention to its crucial aspects. This simplified model of reality allows one to make sense of the situation and engage in further problem solving. A good strategic diagnosis does more than explain a situation—it also defines a domain of action.”

Guiding policy

“This is an overall approach chosen to cope with or overcome the obstacles identified in the diagnosis. It is a signpost marking direction forward, but not details of the trip.”

“A good guiding policy tackles the obstacles identified in the diagnosis by creating or drawing upon sources of advantage. Indeed, the heart of the matter in strategy is usually advantage. Just as a lever uses mechanical advantage to multiply force, strategic advantage multiplies

the effectiveness of resources and/or actions. Importantly, not all advantage is competitive. In non-profit and public policy situations, good strategy creates advantage by magnifying the effects of resources and actions.”

Coherent actions

“Coherent actions represent a set of feasible steps (policies, resource commitments, actions) that are coordinated with one another to work together in accomplishing the guiding policy. Strategy is primarily about deciding what is truly important and focusing resources and action on that objective. It is a hard discipline because focusing on one thing slights another.”

“Strategy is visible as coordinated action imposed on a system. It is an exercise in centralized power, used to overcome the natural workings of a system. This coordination is unnatural in the sense that it would not occur without the hand of strategy.”

“In modern economies, trillions of decentralized choices are made each year, and this process can do a pretty good job of allocating certain kinds of scarce resources. But decentralized decision making cannot do everything. It may fail when either the costs or benefits of actions are not borne by the decentralized actors. The split between the costs and benefits may occur across organizational units or between the present and the future.”

“The potential gains to coordination do not mean that more centrally directed coordination is always a good thing. Coordination is costly, because it fights against the gains to specialization, the most basic economies in organized activity. To specialize in something is, roughly speaking, to be left alone to do just that thing and not be bothered with other tasks, interruptions, and other agents’ agendas. Thus, we should seek coordinated policies only when the gains are very large.

ACTION PLAN

Steps for each action point are given in the tables below. In all cases, evidence of success (*i.e., How will you know that you are making progress? What are your benchmarks?*) is tracked via corresponding reports to Office of Director (see below). Relevant benchmarks are given in those reports. In addition, the evaluation process (*i.e., How will you determine that your goal has been reached? What are your measures?*) compares IPB performance in all action points (as measured by relevant KPI's) to that of global leaders.

Resources needed for all action points already exist at IPB internally, so no additional resources have been listed. Risks associated for implementing these action points have been deemed minimal. Where needed they will be stated within the corresponding reports to the Office of Director.

Note: This part of the document is not public.