

# BIG INNOVATION CENTRE

## RESPONSE TO: Science budget and Industrial Strategy

### Inquiry: Science budget and Industrial Strategy

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In this submission, we respond to two areas on which the Science and Technology Selection Committee seek evidence and information<sup>1</sup>:

- Inquiry 1. “The balance between different parts of the country in Government funding of research/innovation, the effectiveness of such place-based financial support, and how planned place-based funding might affect that balance in future”;
- Inquiry 2. “What further measures the Government should take to use its spending and facilities to strengthen innovation, research and associated ‘place’-based growth

### Summary:

<p>Inquiry 1.</p> <p>An uneven distribution of funding for research, development and innovation is confirmed.</p> <p>The effectiveness of funding is equally expected to vary as economic development requires a complete innovation system, from healthy industry supply chains to socio economic factors and more.</p> <p><b>Solution:</b></p> <ul style="list-style-type: none"><li>• Create regional growth-hubs across the UK using a ‘opening up of the system’ approach,</li></ul>	<p>Inquiry 2.</p> <p>The Industrial strategy is lacking modern diagnostic tools (economic models based upon a past economy are dominating the discussions) or Big data, mapping our knowledge of each place, sector, region and infrastructure, and without taking advantage of AI and the Internet.</p> <p>Place based innovation needs development using economic data and modern diagnostic tools. Big data should inform the implementation of the industrial strategy and when setting the budget.</p>
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<sup>1</sup> Published at <https://www.parliament.uk/business/committees/committees-a-z/commons-select/science-and-technology-committee/news-parliament-2017/science-budget-inquiry-launch-17-19/>

<p>focusing on co-investment and developing a range of innovation systems, while funding research/innovation:</p> <ul style="list-style-type: none"> <li>— Modern industrial <b>system</b>,</li> <li>— Innovative start-up <b>system</b></li> <li>— Entrepreneurial and purposeful talent <b>system</b></li> <li>— Capable global <b>system</b></li> <li>— People’s livelihood <b>system</b></li> <li>— Modern urban and regional <b>system</b></li> <li>— Modern management <b>system</b></li> <li>— Regional demonstration <b>system</b></li> </ul> <ul style="list-style-type: none"> <li>• Target research/innovation and development and investment into specific technological areas of the 4<sup>th</sup> industrial revolution. For example, make each city, home, road (car), sector and workplace in the UK AI ready by 2025.</li> </ul>	<p><b>Solution:</b></p> <ul style="list-style-type: none"> <li>• Government and the public sector must become a lead user of a new and better data infrastructure to inform and strengthen innovation policies and place based innovation led growth. They must utilize platforms which integrate all public and private data sources.</li> <li>• We also propose using ‘Diagnostic tools’ with Artificial Intelligence (AI) for a real-time (always up to date) live-assessment, that customises the information needs for development of each region.</li> <li>• Data reporting and collection structures should be fit for purpose.</li> </ul>
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The above recommendations are briefly described in further details below (see **Section 1** and **Section 2**). However, first we propose a solution using big data diagnostics.

Big Innovation Analytics Platform

The proposed solution using big data diagnostics of UK’s sectors and places can be implemented by the Big Innovation Centre’s ‘Big Innovation Analytics Platform’, described just below. (Innovate UK co-funded its development)

Big Innovation Centre is developing hundreds of AI and big data driven diagnostic tools to map each region of the UK, including cross-cutting innovation supply chains and global systems. Building a holistic **systems** approach (see above) for strategic planning, we are able to use socio-economic big-data to ‘health check’ industries, sectors and places. They can also be used to showcase capabilities and performance, in order to allocate government funding, financial capital, business deals, and foreign direct investment.

Underpinning these tools is a database of some 4 billion records on businesses, research, talent and industry activity, as well infrastructure and socioeconomic data to provide a full picture of a geographical area’s activity and to add value to data on people and organizations. For optimal analytics, the data records are cleaned, optimally organised and freed from errors, which is critical task. We have developed our own machine learning and related tools to automate the acquisition, analysis, cleaning and ingestion of records from over 7,000 repositories from around the world,

including the UK. This is the platform we can leverage to bring our diagnostic solutions to our clients.

Big Innovation Centre would be delighted to develop bespoke diagnostic tools and user-friendly visuals for UK national and regional governments to be used in their strategic planning. For example, we can also support you in communicating technological, sectoral or national contribution/impact online or in print-on-demand reports, and you will learn about the innovation supply chain in any field and where the hot-spots are. The results can also be shown on interactive high-spec screens on the wall (e.g. in government buildings), or via a mobile app.

We envisage, therefore, that the solution delivered will have three main elements;

- A *public dashboard* displaying online *live-visualization* interactive infographics and key metrics about the research sector and place based innovation systems.
- A *private dashboard* displaying online *live-visualization* interactive infographics, and key metrics about bespoke elements to bespoke segments of the economy. This will include a portal, displaying more detailed information than to the general public, that is core to regional strategy, investors, business operations and competitiveness.
- Automated print-on-demand reports with visuals and text generated from the data.

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## **Section 1. The balance between different parts of the country in Government funding of research/innovation, the effectiveness of such place-based financial support, and how planned place-based funding might affect that balance in future.**

It is no surprise that we need to rethink the distribution of research funding for all the regions of the UK to prosper. It is not only for the national benefit but also for the local regions and cities. Currently, as evidenced in Figure 1, from all of the current active grants provided by UK Research Councils, high concentration of research funding goes to the regions of South East, East of England and the London region<sup>2</sup>.

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<sup>2</sup> Darker shading represents higher value for each row.

**Figure 1. Distribution of Grants as a percentage of the value of awards made by a Research Council in a Region<sup>3</sup>**

Yorkshire and The Humber	11.61	8.71	9.46	6.07	1.95	4.58	7.68	9.61	4.64
West Midlands	7.4	6.65	6.64	3.66	3.67	3.92	1.33	2.73	5.41
Wales	3.12	2.05	1.98	4.29	0.64	2.62	1.26	2.54	2.88
South West	7.56	5.94	7.96	4.77	23.5	3.7	0.44	14.73	2.19
South East	15.36	13.44	17.53	12.92	12.67	16.96	22.55	20.96	15.79
Scotland	8.92	14.04	10.27	10.34	2.16	11.26	17.64	12.43	13.67
Outside UK			0.02	1.17		0.85		1.17	
Northern Ireland	3.11	0.56	0.92	1.6	1.66	0.77	1.56	0.17	1.87
North West	9.47	9.66	9.32	7.44	3.02	7.09	3.43	7.82	17.53
North East	4.88	2.76	3.68	2.04	3.53	4.08	4.92	3.32	8.98
London	17.11	13.57	20.01	24.62	31.97	32.43	17.43	8.94	15.48
East of England	6.27	15.65	6.8	18.46	3.83	8.18	10.35	12.16	7.89
East Midlands	5.51	6.98	5.43	2.61	11.38	3.56	11.41	3.41	3.68
	AHRC	BBSRC	EPSRC	ESRC	Innovate UK	MRC	NC3Rs	NERC	STFC

**Figure 1 (A). Distribution of Grants as an aggregate value of awards made by a Research Council in a Region**

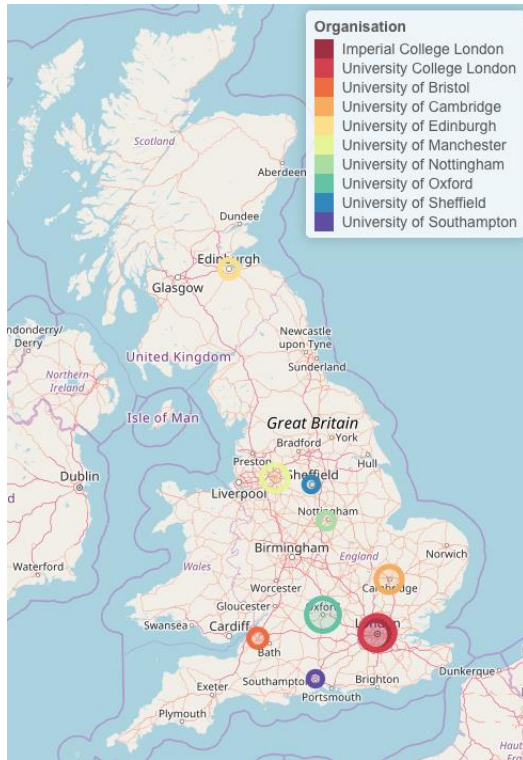
Yorkshire and The Humber	£ 30,668,556	£ 109,892,617	£ 487,485,052	£ 62,770,352	£ 15,761,668	£ 68,809,072	£ 1,562,336	£ 72,058,565	£ 24,688,314
West Midlands	£ 19,539,046	£ 84,000,197	£ 341,961,494	£ 37,824,413	£ 29,673,788	£ 58,899,052	£ 270,000	£ 20,456,752	£ 28,789,297
Wales	£ 8,254,817	£ 25,840,375	£ 101,882,455	£ 44,331,788	£ 5,144,232	£ 39,412,848	£ 255,607	£ 19,060,951	£ 15,294,282
South West	£ 19,975,361	£ 74,966,196	£ 409,967,752	£ 49,313,000	£ 189,825,813	£ 55,550,497	£ 90,000	£ 110,497,583	£ 11,621,079
South East	£ 40,580,604	£ 169,590,466	£ 902,961,207	£ 133,457,517	£ 102,368,650	£ 254,880,477	£ 4,586,694	£ 157,270,686	£ 83,943,382
Scotland	£ 23,555,679	£ 177,231,159	£ 528,878,000	£ 106,805,837	£ 17,460,393	£ 169,236,899	£ 3,586,818	£ 93,237,237	£ 72,672,991
Outside UK			£ 1,204,510	£ 12,118,546		£ 12,840,568		£ 8,787,618	
Northern Ireland	£ 8,206,419	£ 7,040,023	£ 47,329,065	£ 16,488,852	£ 13,424,494	£ 11,591,134	£ 318,176	£ 1,279,435	£ 9,949,562
North West	£ 25,011,238	£ 121,913,904	£ 480,088,444	£ 76,916,036	£ 24,389,509	£ 106,586,285	£ 697,271	£ 58,699,221	£ 93,196,006
North East	£ 12,088,505	£ 34,809,189	£ 189,606,370	£ 21,122,330	£ 28,489,113	£ 61,342,864	£ 1,000,851	£ 24,897,051	£ 47,726,254
London	£ 45,214,817	£ 171,299,006	£ 1,030,847,601	£ 254,438,225	£ 258,253,992	£ 487,350,812	£ 3,544,306	£ 67,096,688	£ 82,317,893
East of England	£ 16,554,096	£ 197,540,657	£ 350,236,466	£ 190,717,414	£ 30,973,770	£ 122,886,357	£ 2,104,235	£ 91,232,032	£ 41,930,152
East Midlands	£ 14,568,736	£ 88,156,975	£ 279,531,804	£ 26,977,286	£ 91,915,620	£ 53,542,479	£ 2,320,911	£ 25,615,482	£ 19,548,280
	AHRC	BBSRC	EPSRC	ESRC	Innovate UK	MRC	NC3Rs	NERC	STFC

For the Research and Development (R&D) amount received by universities, the south is still the largest beneficiary.

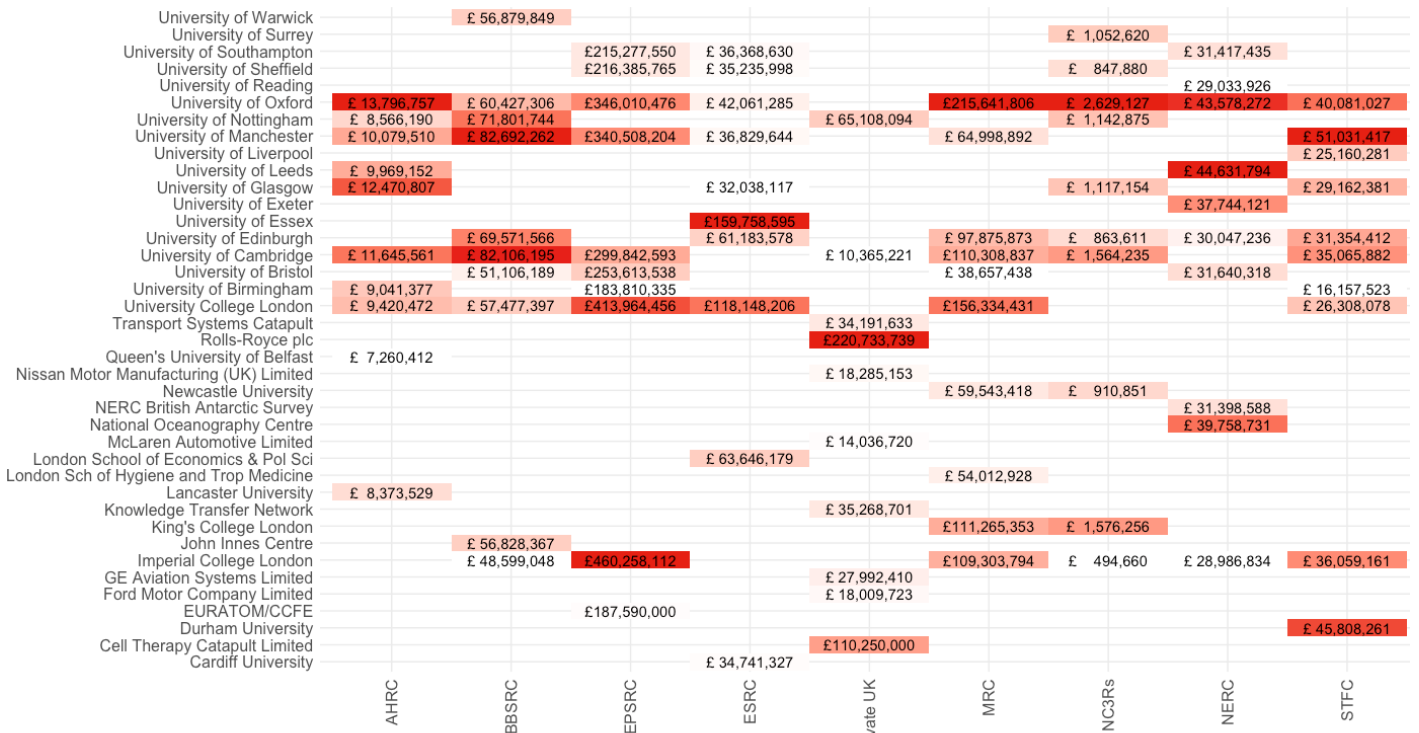
**Figure 2** below depicts the top ten research funding recipients concentration across UK. The size of the circles in the figures is proportional to the amount of funding and different colour for the organisation.

<sup>3</sup> Arts and Humanities Research Council (AHRC); Biotechnology and Biological Sciences Research Council (BBSRC); Engineering and Physical Sciences Research Council (EPSRC); Economic and Social Research Council (ESRC); Medical Research Council (MRC); Natural Environment Research Council (NERC); Science and Technology Facilities Council (STFC); National Centre for the Replacement, Refinement and Reduction of Animals in Research (NC3Rs); InnovateUK

**Figure 2. Location of Top 10 Research Funding Institutions. Adjacent graph shows the aggregate value of research council funding awarded to top 10 recipients in the UK.**



**Figure 3. Distribution of grants as the aggregate value of research council funding awarded to institutions. We list the top 10 recipients funded by each research council and Innovate UK.**



Darker shadings represent higher funding of currents live grants. E.g. Rolls-Royce plc is the top recipient from Innovate UK, and UCL is the highest recipient from EPSRC.



## Section 2. What further measures the Government should take to use its spending and facilities to strengthen innovation, research and associated 'place'-based growth.

To initiate 'place'-based development and to balance the research funding across the UK, there are lessons to be learned from China in transforming our regions to economic growth spots. CEO of Big Innovation Centre went on an innovation tour of six technology and economic development zones in China (the regions are listed in Figure 5) to study their high growth strategy.

**Transforming our regions and our supply chains to become innovation hubs like Silicon Valley, Boston or Bangalore is a major aspiration for the United Kingdom.** There are global exemplars of what works. Whereas Silicon Valley and Boston developed with close links to world class Universities, Bangalore developed with close global supplier links to Silicon Valley until it became a thriving hub in its own right. Eindhoven, located in a much smaller provincial part of Europe, took a different route with Philips Electronics (a big corporate) as the hub – but with a good-enough local university and looking to outsource IP and technology to an innovative supplier network. Philips Electronics crowded in expertise from world-class academics – often created a link to the local university - and opened space for entrepreneurs to co-create with them locally. They invested in new buildings and converted outdated factory space 'not fit for purpose'. All the approaches created opportunities for the local regions to upgrade.

However, **British regions have few comparable assets, nor have our own efforts so far have shown much success.**

China has taken a different, more systemic approach – what it characterises as an 'Opening up of the system' approach for regional and economic development, transforming regions and cities with high tech clusters, industrial parks, and taken millions of people out of poverty. The method included development from economic data and 'achievements from system construction' (as opposed to classic macro indices).



Systems display



Development from economic data



Achivement from system construction

Their approach was solution oriented, - on solving specific problems. Very different than focusing on growth value added (GVA) or local productivity measures, which are non-operational. We hereby propose what such questions should be:

**Figure 4. Big Innovation Centre’s proposal for diagnostic questions to build economic growth hubs**

OPENING-UP THE SYSTEM:	THE NEED FOR DIAGNOSTIC TOOLS TO ASSES IN NUMBERS, TEXT AND VISUAL DISPLAYS:
1. Modern industrial system	1. Is our industrial system modern enough? What is the balance between current and emerging industries, supply chain systems, and firms embodying the fourth Industrial revolution?
2. Innovative start-up system	2. How innovative is our local Entrepreneurship start up system? What are the strengths on which to build?
3. Entrepreneurial and purposeful talent system	3. How innovative is our local Entrepreneurship start up system? What is the support for scale-ups?
4. Capable global system	4. Are our universities poles for talent generation? Is our university talent system pervasive and impactful?
5. People’s livelihood system	5. Do we have a capable global trading system in all UK regions?
6. Modern urban and regional system	6. What does our people’s livelihood system look like in our cities? How attractive are our cities to live in? (deprivation, crime, health, access to culture and education, infrastructure, shopping and entertainment?)
7. Modern management system	7. Is our urban and regional system fit for 21st century high speed low cost transport, sustainable housing, and effective land-use?
8. Regional demonstration system	8. Do our existing public management systems get it? Are there sufficient private managers of the right quality? Who makes a difference?
7. Modern management system	8. What do our regions proto-type and do they have demonstration system fit to attract inward investment and foreign direct investment?
8. Regional demonstration system	<p style="color: red;">These questions must be foregrounded and above all casted systematically in regional terms and means developed to provide answers on the ground.</p>

**The aim should be to support a budget aimed to build catalytic innovation and investment hubs in all the regions of the UK.** Focus should be on all systems forming part of catalysing the science and innovation landscape.

As seen in the figure below, the government of China started the process of ‘place’-based development by initially identifying the key regions and their capabilities. These regional capacities were further developed by using a systems approach which was adopted in each place, as described above. This included prioritisation of sectoral government funding, other required infrastructure in combination with the appropriate talent pool.

**Figure 5. Examples of economic and technology development zones using this approach**



To complement the ‘open-system’ approach the UK government should advance its capability to collect, manage and analyse big data looking towards developing a 21<sup>st</sup> century data infrastructure. Hence, with the ‘open-system’ approach we propose:

- Creating a single data platform integrating private and public data.
- Building a diagnostic tool to efficiently use data to inform policies and development.

**Big data and AI should inform the industrial strategy and the budget: government must become a lead user of new and better data infrastructure.**

The data revolution with Artificial Intelligence goes beyond public services. It is the foundation of our economic planning. Clearly, a 21<sup>st</sup> century government reporting framework on the economy, productivity measurements and regions, should capture the performance of the current state of affairs. Nevertheless, the UK data system is technologically outdated, methodically stuck in the past and costly to run. Therefore, the numbers could be misleading and redundant.

Consequently, the government is unable to adequately plan its budget, infrastructure investment, tax levels, and public expenditure for research, education, skills and social issues. It is also struggling to decide the sectors and technologies around which to develop support strategies. Business leaders themselves cannot set sound strategies for their investment and performance efficiency challenges, especially around intangibles and business models.

Big Innovation centre have identified three key challenges on the existing data collection, management and usage in the UK.

*First, government data collection and measurements do not capture knowledge-based services, new forms of manufacturing, and the digital economy including the effect of new forms of work,*



automation, smart devices, robotics and AI. The conceptual, theoretical and measurement frameworks developed for a physical paradigm and the past industrial revolution, need re-addressing. For example, productivity measures used by national income accounting focus on quantities produced and physical measures such as machinery, buildings and hours worked. The **dimensions of quality, sustainability and service generated by intangibles are not captured even though they are vital for successful company investment and government policy alike**. Productivity measures are outdated, fitting better to the post-war industrial economy than today's knowledge-based digital economy, which is a disservice to the UK's thriving digital start-up industry.

Energy, health, transport, finance and retail are five major sectors where consumers are expecting improved quality and sustainability as opposed to more quantity. Most contemporary value-added work is the deployment of information technology (IT) and intellectual capital in production, services and manu-services: here people do not produce more 'stuff', but increase its quality. For instance, consumers want help to economise on their bills and not buy more energy, they do not want to be stuck in traffic, and they want to stay healthy. Similar for financial services.

*Second*, **collection structures are not fit for a common purpose** (segmentation, structure, sometimes high transaction costs, sometimes analogue, and data gaps often making machine learning impossible, so investment in data cleaning is essential). Public data sources are varied and include company annual reports, and (in the UK) Office for National Statistics, Companies House, Treasury and Bank of England. The problem is, these have all been developed for unique and different purposes. Although searching is possible, this is usually restricted to a single source and lacks the big data crunching ability to develop consistent themes and coherent numbers. The problem is particularly evident in companies (especially SMEs) looking to strengthen their supply chain or looking for supply chain partners to develop their R&D, their manufacturing, or customer reach.

- Companies and **regions (even national strategies) are operating without diagnostic tools**, detail or proper context of their supply chains.
- Supply Chain analytics models are rare and outdated at best: firstly, they are modelled on the features of a past economy as opposed to how it really works; secondly, they don't utilize internet AI or big data to intelligently identify companies, sectors and regions' supply chain facts, opportunities and solutions.
- Current reporting on supply chains in companies or regions is not interactive, but fixed in static reports or diagrams.

*Third*, **data are not collected for a specific purpose**, usually excluding useful supply-chain information. For instance, to develop our Industry, start-up or talent systems. **The industrial strategy is operating without diagnostic tools or proper context**. Same for the regional strategy, or UK's infrastructure investment.

In summary, **economic analytics models are outdated**. On one hand they are modelled on the features of a past economy and on the other, they are not taking advantages of new technologies and AI.

The vision must be to create an ambitious and trusted **21<sup>st</sup> Century UK Data Infrastructure**, which supports the growth of the economy to benefit the private and public sector alike across the UK. This means **integration of public and private data collection sources on one platform** (information system), an **upgraded focus on innovation and intangible asset data**, and direct link with **stakeholder use and purpose**.

Big Innovation Centre has piloted **diagnostics tools** (see Summary above) using artificial intelligence for a real-time online assessment of the skills base and innovation capabilities of the UK regions. These tools are designed across an agreed set of industrial and entrepreneurial segments, which supply our business, trade and job base. We investigate the **capabilities of the education and talent system, which provide the skills base for the future**. We address the capacities of our transport in travel to work places and infrastructure system as well as highlight areas of deprivation with respect to health, crime, access to opportunity and culture.

The tool will assist in building a strong data infrastructure with an upgraded focus on innovation, research and intangible asset data, and direct link with stakeholder use and purpose. Currently, we hold 4 billion cleaned data across 7000 data sources.

We propose to encourage 'place'-based growth using 'Opening up of Systems' approach for balanced regional investments. Along with this approach we recommend the government to lead in utilizing a modern data infrastructure for creating informed industrial strategy and budgets for the upcoming industrial revolution. This process should be complemented by building bespoke diagnostic tools for real time assessments to inform research and innovation funding.

## **BIG INNOVATION CENTRE**

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***Prepared for the Science and Technology Committee***

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