
Startup Genome
GEN
G20 Pilot
APEXE Nations Report
Aptitudes and Policies for EXponential Entrepreneurship
How countries translate innovation potential
into exponential entrepreneurship.
STARTUP BRASIL 2024
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Startup Genome

Impactful innovation policy powered by global experience and data-driven knowledge.

Startup Genome is the world-leading innovation ecosystem development organization, having worked with more than 170 economic and innovation ministries and public/private agencies in over 60 countries.

We work to catalyze startup success and ecosystem growth and ensure that all cities and countries capture their fair share of the new economy. Startup Genome strategy clients grew their ecosystem values 59% faster than peers (41% vs. 25%). On average, Startup Genome clients produced $1.4 billion per year more in ecosystem value from an average starting point of $9.2 billion. Our evidence-based ecosystem research, advisory, and scaleup programs are rooted in global experience with the world's largest AI-curated startup dataset and proprietary instruments developed from over a decade of primary research.

Startup Genome's Services

We work with forward-looking governments and private sector organizations to accelerate the success of their startup ecosystems to fuel the growth of more startups, sustainable economic growth, and job growth.

Knowledge Exchange

- Establishing a global network of innovation policymakers in 60+ countries
- Providing access to the latest research and policy best practices, and facilitating shared learning
- Organizing member meetings and leadership forums for networking and collaboration

Positioning

- Enhancing ecosystem visibility and strategic positioning
- Focusing on attracting entrepreneurs, talent, and investors through targeted efforts
- Achieving global reach through our reports, events, and media outreach

Assessment

- Utilizing renowned frameworks and data science capabilities for decision-making
- Assessing ecosystem performance and strengths through data analysis
- Benchmarking against peers for competitive advantage and growth opportunities

Strategy

- Developing strategies for ecosystem development and differentiation
- Conducting scenario modeling to determine economic impact
- Creating clear and aligned-upon multi-year roadmaps for implementation

Execution

- Supporting local leadership in executing key policies and programs
- Measuring and reporting the impact of initiatives
- Delivering services in collaboration with global thought leaders

Want to bring our expertise to your startup ecosystems? Contact Marina Krizman, Senior Business Development Specialist, at marina@startupgenome.com

About Our Global Partners

GLOBAL ENTREPRENEURSHIP NETWORK

The **Global Entrepreneurship Network** (GEN) operates programs in 200 countries and territories aimed at making it easier for anyone, anywhere to start and scale a business. By fostering deeper cross-border collaboration and initiatives between entrepreneurs, investors, researchers, policymakers and entrepreneurial support organizations, GEN fuels healthier start and scale ecosystems that create more jobs, provide education, accelerate innovation, and strengthen economic growth.

ABSTARTUPS
ASSOCIAÇÃO BRASILEIRA DE STARTUPS

The **Brazilian Startup Association** was founded to promote and represent Brazilian startups. We are working to make Brazil one of the five greatest powers in technological innovation and entrepreneurship.

Research Partners

crunchbase

Crunchbase is the leading platform for professionals to discover innovative companies, connect with the people behind them, and pursue new opportunities. Every day investors, journalists, founders, and the global business community turn to Crunchbase for information on startups and the people behind them.

dealroom.co

Dealroom.co is a global provider of data and intelligence on startups and tech ecosystems. Founded in Amsterdam in 2013, we now work with many of the world's most prominent investors, entrepreneurs and government organizations to provide transparency, analysis and insights on venture capital activity. Our mission is to accelerate entrepreneurship & innovation through data for governments, corporates and VCs, founders.

Introduction 02

Introducing the APEXE Report - G20 Pilot

With the APEXE Nations Report, Startup Genome and Global Entrepreneurship Network give economic development and innovation ministries of national governments around the world a unique toolkit. As we have built on the city level over 12 years for the Global Startup Ecosystem Report (GSER), the APEXE framework pilots a set of practical benchmarks along with in-depth metrics and assessment tools for national economic development and innovation ministries and agencies.

Over time, the GSER became the #1 barometer used by governments and agencies to measure the effectiveness of their policies and investments into startup ecosystems. The APEXE Nations Report will play the same role at the country level. It pilots the first-ever balanced scorecard of the effectiveness of a country's policy actions and gaps at translating its innovation potential – normalized to produce fair benchmarks – into a tech entrepreneurship engine for their societies, plus a compass for policy action.

Startup ecosystems have become the number one engine of job creation and economic growth all over the world. They are city-based, self-regenerating economic powerhouses that have created seven of the world's 10 largest corporations. Tech companies now account for nearly 50% of the U.S. stock market and that proportion is growing across stock markets globally.

Startup success increasingly drives growth (see Methodology for our definition of startups). Not only do the startup ecosystems of Startup Genome's clients grow faster, but, inevitably, their economies do as well. Economies that invested in startup policies in the mid-1990s, and those that followed their most impactful policies since, are thriving, benefiting from the transition to digital economies — and they will benefit for decades to come. Others are increasingly struggling as they have delayed inevitable investments in startup ecosystems.

Tech startup ecosystems have grown faster over the last three decades than any other sector — even faster than the automotive sector 100 years ago, semiconductors, and telecom. Corporate and university R&D has diminished in relative importance, in terms of its power to drive a city or country's economic prosperity. Many corporations have understood that fact and now spend more resources on engaging with startups in various open innovation activities than they do on internal R&D.

Yet, too few governments have dedicated proportionate budgets to invest in their increasingly important startup ecosystems. Through this status quo, governments continue to bet their future economies on the diminishing return of traditional economic development plans, or hope that their edge in traditional R&D will help fuel their economies for a few more years. Unfortunately, university talent and IP are mobile and their value is increasingly captured by global corporations in other countries or continents. Corporate R&D is fraught with the same mobility problem, while efficiency gains reduce employment and value is eroded by the relentless and growing tech competition.

The future of every economy and of its next generations depends on immediate and large investments in the development of startup ecosystems.

The Economic Potential of Startups in the G20

Startup ecosystems produce tremendous value, creating novel products and business models that create jobs, increase corporate competitiveness, drive economic growth, and often address social challenges. For a city, a portion of this value can be quantified by its tech startup's Ecosystem Value (EV), a measure that has become the standard way to benchmark local startup ecosystems globally.

Ecosystem Value is the sum of all startup exits and funding valuations of the past 2.5 years. In the United States, for example, the national Ecosystem Value (the sum of all of its cities' startup ecosystems) at the end of 2023 was $3.9 trillion. This means that the current

The future of every economy and of its next generations depends on immediate and large investments in the development of startup ecosystems.

value of U.S. startup ecosystems is equivalent to 14% of GDP. Note that while we realize GDP is a measure of production rather than asset value, the ratio of Ecosystem Value to GDP (EV/GDP) is a useful gauge of value created. Note also that Ecosystem Value is focused on tech startups and recent exits and therefore it does not count the valuation of the large tech companies produced over time.

The G20 Startup Ecosystem Opportunity: Unlocking Trillions in Economic Value

There is huge variation across the G20 countries: Japan currently has a national Ecosystem Value equivalent to only 1.7% of GDP, while Italy's ratio is just 0.8% – far below the average EV/GDP ratio of 8%. These gaps between the leading and lower-performing countries represent significant opportunities for additional value creation if these countries can grow their startup ecosystems to become closer to the G20 average.

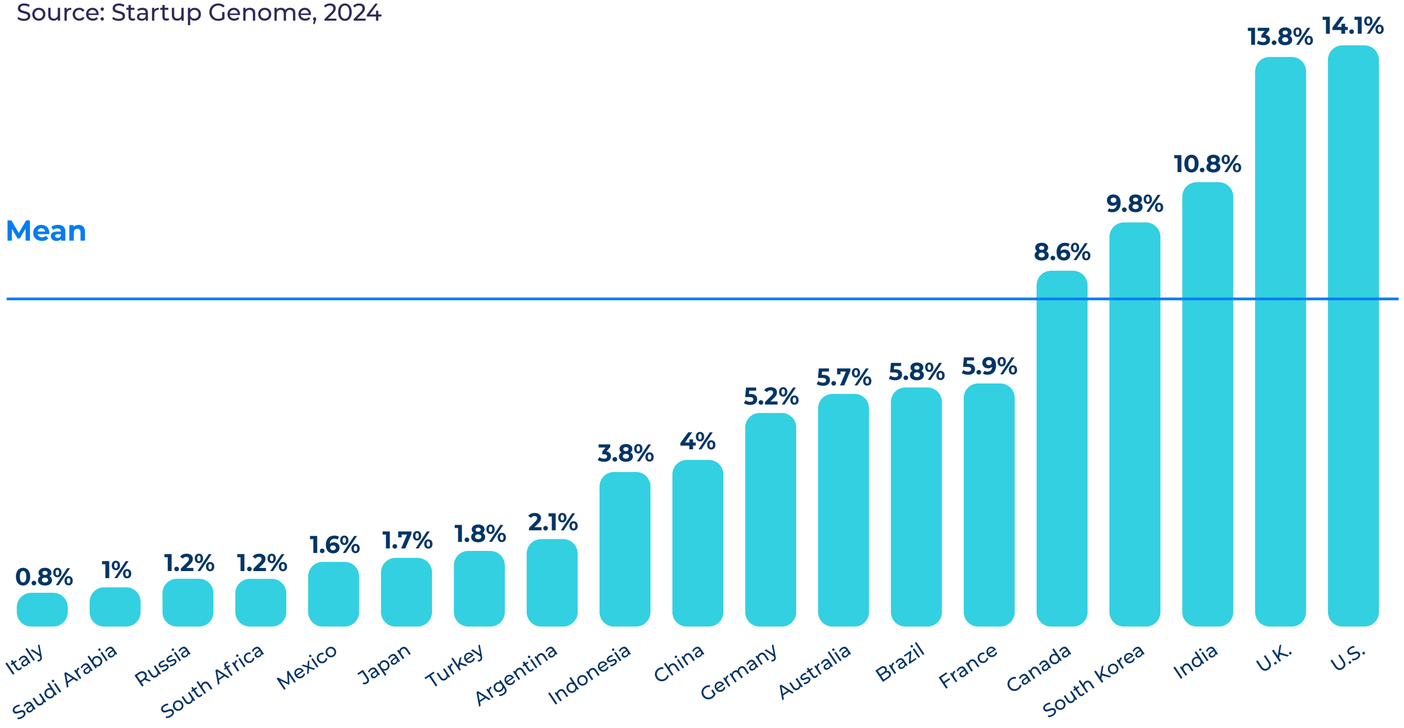
To quantify the size of the opportunity: if it were possible for the lower-performing G20 countries to all reach the average Ecosystem Value to GDP ratio, this would add a staggering additional $2.7 trillion in Ecosystem Value to the global startup economy.

The Economic Value of Startups

Startup Ecosystem Value Averages 8% of G20 GDP

Startup Ecosystem Value to Gross Domestic Product (EV/GDP)

Source: Startup Genome, 2024



But is increasing a country's Ecosystem Value to GDP ratio remotely possible – or do some G20 countries simply lack the necessary ingredients to grow their startup ecosystems? How do we know if countries are already maximizing their startup potential?

Ecosystem Value to GDP, while offering a snapshot, is a relatively crude measure which does not tell us if a country is converting its potential into startup ecosystem success. Instead, we need a range of factors – principally, how much innovation has occurred and whether this has been effectively channeled into startups – to determine if their potential has been maximized.

APEXE Report's Innovative Framework

This is where the APEXE Report ranking offers a sophisticated new framework and set of factors that reveal the following:

1. What is a country's innovation potential?

2. What is a country's startup ecosystem performance?

3. To what degree has a country translated its innovation potential into startup ecosystem performance?

If every country's startup ecosystem performance, corporate fabric, economic strength, and innovation output and quality are carefully measured and normalized for the size of their population and GDP, Startup Genome's Lab-to-Startup score should allow small and large countries across all continents to fairly compete for top ranks.

Approach to the New APEXE Report

To answer these questions, this pilot report creates a data-driven, reproducible framework to help countries realize their potential for innovative entrepreneurship by measuring how effectively they are presently using that potential. The APEXE Report offers a first-ever view of startup ecosystems on the national level, complementing the annual Startup Genome Global Startup Ecosystem Report (GSER). The GSER provides a city-level analysis and comparison of different ecosystems around the world, helping local entrepreneurs and policymakers better understand the conditions for entrepreneurship and focus their efforts most effectively.

The APEXE Report captures the many additional factors which influence startups on a broader scale. For example, laws affecting businesses, such as the ability to offer stock options, are frequently set at the state or national level. Regulations surrounding taxation, such as tax relief for investors, are often nation-wide. Policies for talent, such as education strategies and visas for incoming entrepreneurs, are usually national in nature, and so on.

With the APEXE Report - G20 Pilot, we are providing a compass, pointing national governments toward more prosperous societies. The inaugural APEXE Report focuses only on the countries within the G20, although it is anticipated that future editions will expand the ranking considerably, including a wider range of analyzed countries and indicators.

This pilot report creates a data-driven, reproducible framework to help countries realize their potential for innovative entrepreneurship by measuring how effectively they are presently using that potential.

Global Rankings & Insights

03

2024 Rankings

Normalized by GDP and/or population

COUNTRY	APEXE G20 RANK	POLICY ACTIONS LEVEL	LAB-TO-STARTUP G20 POSITION	INNOVATION POTENTIAL TIER	STARTUP ECOSYSTEMS SCORE
UNITED STATES	1	6	1	9	2.26
UNITED KINGDOM	2	7	2	9	1.87
CANADA	3	7	4	8	1.39
INDIA	4	4	3	3	1.22
SOUTH KOREA	5	7	6	8	1.28
FRANCE	6	8	8	7	1.14
CHINA	7	6	5	5	1.02
AUSTRALIA	8	8	10	9	1.17
GERMANY	9	6	9	9	1.18
ARGENTINA	10	6	12	3	0.65
TURKEY	11	6	14	4	0.68
JAPAN	12	6	16	8	0.95
BRAZIL	13	3	7	4	0.90
MEXICO	14	5	11	3	0.64
INDONESIA	15	5	13	4	0.71
ITALY	16	6	18	6	0.72
SAUDI ARABIA	17	6	19	5	0.62
SOUTH AFRICA	18	5	15	3	0.62
RUSSIA	19	5	17	3	0.59

Selected Analyses

India #4

India's Startup Ecosystems Performance is very high compared to its Innovation Potential, positioning it third in Lab-to-Startup Conversion among the G20. A very high EV/GDP ratio of 10.8% and having three startup ecosystems ranking in the GSER Top 40 both exemplify this conversion. However, India's overall APEXE rank is lowered to #4 by relatively low startup Policy Actions.

China #7

While the traditional innovation output and quality of China's top cities is very high, at the country level — with its very large GDP and population — its normalized Innovation Potential is lower than peer average. However, its Startup Ecosystems Performance is above average with, for instance, four ecosystems in the GSER Top 40. If it fixed key gaps in startup policies, China could contend for a top three APEXE rank.

Lab-to-Startup Conversion: Startup Ecosystems vs. Innovation Potential Scores

Top 10 APEXE G20 Countries Highlighted

Selected Analyses

Germany #9

Germany's normalized Innovation Potential is the highest among the G20. Yet, its Startup Ecosystems Performance is barely above average with, for instance, an EV/GDP ratio of 5.2% and only two GSER Top 40 startup ecosystems vs. three for Canada. In addition, its startup policies show several important gaps.

Brazil #13

As Brazil's strong EV/GDP ratio (5.8%) suggests, its Startup Ecosystems Performance outperforms its lower Innovation Potential by reaching the 7th position in Lab-to-Startup Conversion. However, its gaps in startup Policy Actions lowers its APEXE rank to #13.

Tech entrepreneurship has become the #1 engine of job creation and economic growth all over the world. Startup Genome and Global Entrepreneurship Network are providing national governments with a scorecard of how effective their actions have been at building up exponential entrepreneurship, adjusted for their countries' innovation potential and balancing its assets, strengths, and weaknesses. With the **APEXE Report - G20 Pilot**, we are providing a compass for what national governments can do better to build prosperity for their societies.

Startup Genome is the #1 policy advisor to national governments.

GEN is the global network supporting governments with policies and programs.

To add your country to the APEXE Report or to discuss how our experience- and evidence-based approach can positively transform your national ecosystems, reach out to both Marina Krizman at Startup Genome and Matt Smith at GEN at **apexe@startupgenome.com**.

Methodology 04

Methodology

Methodological Approach

While the core question of the GSER is "Which city-level startup ecosystems maximize the chances of an entrepreneur to build a very big success?", the core question of the APEXE Report is "How good are countries at converting their innovation potential into exponential entrepreneurship?" The primary audience is intended to be policymakers to focus attention on the areas they should address to further boost entrepreneurial innovation in their countries.

The APEXE Report takes a different approach to many other indices: rather than just measuring the factor conditions for entrepreneurial innovation (which one might consider "inputs"), or examining metrics relating to entrepreneurial activity and performance, it examines the difference between certain factor conditions and entrepreneurial activity and performance. It also scores relevant startup policies a country has put in place.

In other words, we not only expect that countries with higher levels of traditional innovation will have higher startup performance, but our methodology seeks to measure whether this performance is above or below expectations; we term this Lab-to-Startup Conversion. To this is added to a Policy Score, reflecting a number of policy areas related to startups.

To enable a fair comparison across a wide variety of countries, we normalize many metrics. While the GSER effectively normalizes city-level startup ecosystems by defining a standard geographical size for all of them, that is not possible on a country level. We therefore seek to avoid metrics that reward or penalize countries for size alone. Furthermore, for metrics with skewed distributions (such as the number of patents and Ecosystem Value) we either normalize them to the country's population or GDP, or use the log of their values.

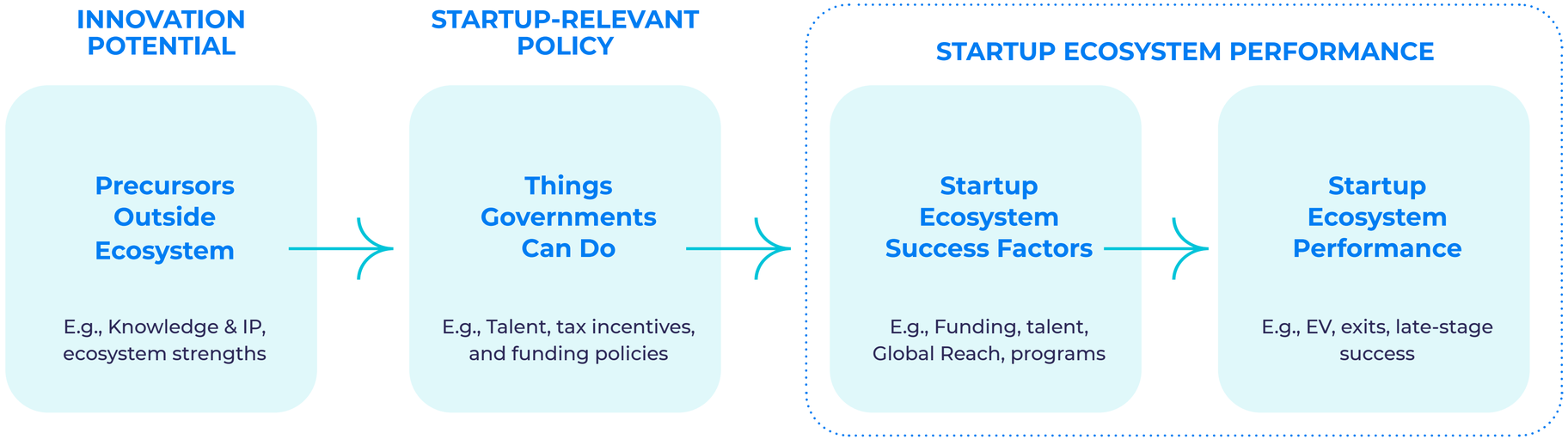
As one example, even though it is clearly helpful for firms to be able to sell into a large domestic market (and some other indices consider this as an important factor), we do not include domestic population within the evaluation of local market conditions. This is explained further below. In this way, we attempt to avoid simply ranking the largest or richest countries, or those that have produced the most startups to date, but rather to provide a comparison of which countries are making the most of their potential.

Note: Startup Genome defines startups according to Steve Blank, one of our foundational collaborators and a global tech thought leader, as "temporary organizations in search of a repeatable and scalable business model." They must be innovative and are meant to scale or fail, which therefore excludes all traditional SMBs/SMEs. Being innovative is a fast-evolving criteria that we continuously keep up to date through AI and machine learning algorithms.

Logic Model

Construction of the report started with a conceptual framework. In order to measure how countries were using their potential, we conceptualized the logic model shown below. In this model, potential is defined by precursor conditions outside the startup ecosystem; we also term this the Traditional Innovation Ecosystem. This potential gives rise to the startup activity and consequent performance (collectively termed the Startup Ecosystem), with this process mediated by governmental policy and programs, called Startup-Relevant Policy (or just Policy).

APEXE Model and 'Theory of Change'



Based on this model, we define three main blocks, or Factors:

- **Innovation Potential** is intended to represent the ingredients or components of an ecosystem that are valuable inputs into the entrepreneurial process, but which typically rest outside the remit of a Ministry of Entrepreneurship. As a result, these can only be changed slowly by governments, if at all.
- **Startup Ecosystem** is intended to represent the activity and output of a country's startup sector.
- **Startup-Relevant Policy** is intended to represent the quality of a county's startup-relevant policies and government interventions. The components of this are typically within the remit of a Ministry of Entrepreneurship (or, at least, within government as a whole), and thus should be within the power of a government to change, budgetary constraints aside.

We also define a measure which we call Lab-to-Startup Score, which is a function of Startup Ecosystem Score (2X) minus Traditional Innovation Ecosystem Score.

Effectively, we are measuring whether countries are performing above or below performance expectations built upon their traditional innovation ecosystems and a number of economic and foundational factors. Furthermore, by normalizing both Innovation Potential and Startup Ecosystem Performance metrics by a mix of population size and GDP, we are quantifying to what degree resources across the whole nation — not only that of a few top cities — are being put to bear in producing economic impact through entrepreneurial innovation.

Defining Sub-Factors

Startup Genome's primary research spanning more than a decade and five continents was used to create the missing data needed to assess and model startup ecosystems (see article "**New Science of Ecosystem Assessment and Methodology**"). A number of sub-factors capture, in a normalized fashion, the components that build up startup ecosystem potential (Innovation Potential) and the leading, current, and lagging variables that measure and explain startup ecosystem performance (Startup Genome's Ecosystem Success Factors).

The Innovation Potential Factor was assigned sub-factors relating to Business Foundations, Talent (skills & attitude), Infrastructure, Knowledge and R&D, and Market Access sub-factors. Policy measures were excluded. The Startup Ecosystem Factor was assigned sub-factors relating to Funding, Programs, Performance, and Talent (experience). Policy measures are again excluded.

The Policy Factor represents policies and government actions which affect sub-factors such as startup Funding, Talent, and Global Reach. Policies acting on other factors will be added over time. The rationale for the sub-factors is as described on the right:

Component Sub-Factors

SUB-FACTOR	EXPLANATION
TRADITIONAL INNOVATION SUB-FACTORS	
BUSINESS FOUNDATIONS	Businesses of all types, including startups, need a stable legal and regulatory environment. Founders are reluctant to build businesses in circumstances where, for example, there is a high risk of appropriation by the State, where they do not trust that contracts can be enforced, or where laws may change unexpectedly.
TALENT (SKILLS & ATTITUDE)	Startups are human creations. They are founded by entrepreneurs, whose risk appetite and motivations may be socially-influenced. Founders need to recruit skilled talent – especially STEM students and software engineers – in order to grow. Additionally, English language skills help significantly with access to international venture capital and international expansion. Separately, we also examine several policy areas which are intended to attract and retain talent, such as entrepreneurs' visa schemes, and the availability of stock options.
INFRASTRUCTURE	Many innovative, high-growth startups are digital – that is, they make significant use of internet connectivity as part of their core business operations, and are likely to suffer if connectivity is poor. The state of development of ICT infrastructure within a country is therefore important.
KNOWLEDGE AND R&D	The degree to which a country invests in R&D and produces knowledge and IP is highly important. This is measured through metrics such as Gross Expenditure on Research & Development (GERD), and the production of intellectual property rights like patents and industrial designs.
CORPORATE FABRIC	While excessive dominance by large firms can make it difficult for new firms to enter a market, the presence of large firms – especially R&D-intensive firms – can be helpful to startups, in that the larger firms may serve as service providers, customers and acquirers. Corporates are increasingly interested in open innovation involving startups, using corporate accelerators or other mechanisms.
MARKET ACCESS	It is helpful for young firms to establish some traction and validation in their local market before they expand abroad. Given that many innovative startups produce digital products, the likelihood of finding a local market is increased when the local population is more digitally-skilled. Selling into markets which are expanding, and where there is a relatively high willingness to pay, is also beneficial.

Selection of Metrics

Following the identification of sub-factors, we identified and selected specific metrics and data sources for each.

The guiding principles for metric selection were that the data should be:

- relevant to the sub-factor concerned (and the rationale of the logic model)
- geographically complete (covering as many countries as possible, including those not part of the G20, in order to allow for future expansion of the report and a larger dataset for testing)
- reliable (not containing anomalies, errors, or biases)
- timely (not having a large time lag between the time of measurement and publication)
- likely to maintain publication in the future (in order to allow for future editions)

SUB-FACTOR	EXPLANATION
STARTUP ECOSYSTEM SUB-FACTORS	
GLOBAL REACH	As Startup Genome research demonstrates, a startup ecosystem's ability to produce global category leaders and more broadly, its startup's Global Market Reach, are built upon its Global Connectedness, primarily based on entrepreneurs and startup leaders but also investors, startup programs, etc. Click to read article "**The Need for Global Connectedness**".
FUNDING	Access to funding along with the insights and mentoring of experienced angel investors and VC firms is critical to startup success. Key metrics capture early-stage funding along with the size and experience of the VC community.
PROGRAMMING	Dedicated startup-support programs such as accelerators and incubators have been shown to have several positive benefits – not only for the startups themselves, but also in terms of ecosystem spillovers such as **Local Connectedness**.
TALENT (EXPERIENCE)	A decade of Startup Genome research has demonstrated that startup experience (which includes scaling experience) is one of the strongest predictors of startup performance. As entrepreneurs and other talent, investors, and supporters develop and accumulate experience, both the rate and size of startup success increases.
PERFORMANCE	While most of the above are inputs to the entrepreneurial process, or leading indicators of activity, this is a composite measure of the outputs of entrepreneurship – effectively, a lagging indicator of success. There is a positive feedback loop where success stories stimulate other prospective entrepreneurs and attract international attention to an ecosystem.
POLICY SUB-FACTORS	
STARTUP POLICY	Scoring of startup-specific policies implemented (or in effect) over the last few years by the national government, cutting across factors such as Funding, Talent, and Global Reach. Policies acting on other factors will be added over time.

Invariably, many compromises had to be made in this process. It was often the case that no ideal data source could be found, so we sometimes had to resort to proxy measures (that is, measures which did not directly fit our logic model, but which we had good reason to believe were linked or strongly correlated with the metric we wanted).

In other cases, we had to accept a trade-off between characteristics of the metrics: for example, where data sources had a time-lag, meaning that the data for more recent periods was less complete or more uncertain, we sometimes used slightly older time periods, where the data was more complete – although this risks becoming less representative of the current state of a country, especially for fast-growing ecosystems.

Data Gathering & Imputation of Missing Data

Having selected the desired metrics, we attempted to gather the data. At this stage, it was often discovered that data sources were less complete than expected. Where gaps were large, the dataset was usually rejected in its entirety; where gaps were small (e.g., missing data for a few countries), we had to impute the missing data. This imputation was done on a metric-by-metric basis: in some cases, we could combine different data sources, or use slightly older data from the same source; in other cases, we could use a value for a country which was known to be very similar; in yet other cases, we had to estimate the missing data by taking averages of similar countries. On occasion, we had to amend anomalous data.

Normalization & Standardization

Given the tremendous variation in country size, normalization is obviously needed in order to make any fair comparison. Even restricting ourselves to the G20 countries, there is more than a 50-fold difference in population between largest and smallest, and more than a 60-fold difference between the size of the economies. However, it was not always obvious whether a metric should be normalized, and if so, what the normalizing measure should be. This was further complicated by feedback loops in the logic model.

Where metrics varied over several orders of magnitude, we sometimes used the logarithm of the numbers. One principle which guided this choice was that we generally wanted the distribution of sub-factor scores to be roughly normal distributions.

Adjusted Global Reach is a special case of normalization. This metric is intended to represent the degree to which startups in a country expand internationally, as measured by the percentage of startups from that country which open a secondary office abroad. However, it is clear that startups in very small countries, such as Malta, rapidly exhaust their domestic market; this is demonstrated by an inverse relationship between the logarithm of a country's GDP and the proportion of startups which expand overseas. In this case, rather than using the percentage of secondary offices, we adjust for country size by looking at the difference between the percentage of secondary offices and the number predicted by the inverse function.

In addition to normalizing by GDP or population, data was also standardized (also called z-score normalization), to scale the data to a uniform mean and uniform standard deviation. This is a common data-scaling technique which is useful when dealing with distributions of different scales, and which preserves the shape of the original distribution.

Correlation Analysis

We wanted metrics which were not strongly correlated with one another, since correlation would indicate a high degree of redundancy, adding additional complication to the report with little extra information. In order to suggest redundant metrics, we examined correlations between every possible pair of metrics, and where the correlation coefficient was very high ($r > 0.9$), we considered rejecting one of the pair, and retaining whichever we considered better according to the original selection criteria. (Note: this was performed on normalized data, since unnormalized data – e.g., total STEM researchers vs. coders – would otherwise show many correlations which were simply indicative of the size of the country.) This was further refined when building the regression models (described below).

Weighting and Aggregation

Not all metrics are of equal importance, and the report aims to assign greater weight to the metrics which play a greater role in ecosystem success. In order to guide this process, we undertook a number of multivariable regression analyses to understand the contribution of each metric to ecosystem success. The process was follows:

Defining a Combined Performance Model

For the purpose of this ranking, we define successful ecosystems as those which are creating economic value from startups. In many instances, Ecosystem Value normalized by GDP (EV/GDP) is a good measure of success. However, as discussed above, this is imperfect in some situations (e.g., where a country has produced a few high-value exits but has little other activity). We therefore developed a combined model of success (our Performance Model) that captures a wider range of indicators relating to success. This Performance Model is composed of the metrics listed under Performance above, namely a combination of: Ecosystem Value relative to GDP; a normalized count of Exits over $50M; a normalized count of Exits over $1B; a normalized sum of Late-Stage Funding (LSF) and a normalized count of Unicorns. These components were combined to generate a combined score for each country's ecosystem, representing a weighted, quantified summary of its performance. Note that this Performance Model score contributes towards the final ranking of the report, but is not the final ranking itself; it is introduced in the model as a means of determining what contributes towards success.

In training our regression models (below), we used this Performance Model Score as the dependent variable, and also re-ran the models with the simpler EV/GDP ratio as the dependent variable.

Regression Models

We trained four different regression models, by using (separately) the Performance Model and the EV/GDP ratio as the dependent variable, and other ecosystem metrics as independent variables:

- **Random Forest:** A Random Forest is an ensemble learning method that constructs multiple decision trees and combines their predictions to improve accuracy and reduce overfitting. It captures complex interactions between features by averaging multiple decision tree outputs.
- **Ordinary Least Squares (OLS):** OLS is a linear regression technique that minimizes the sum of the squared differences between observed and predicted values, fitting a straight line through the data points to model relationships between variables.
- **Lasso (L1 Regularization):** Lasso regression introduces an L1 penalty, which constrains the sum of the absolute values of the model coefficients, promoting sparsity by shrinking some coefficients to zero, effectively performing feature selection.
- **Ridge (L2 Regularization):** Ridge regression applies an L2 penalty to the model coefficients, which minimizes their squared values. This regularization prevents overfitting by reducing model complexity without eliminating features entirely.

Each model produced regression coefficients for the independent variables, reflecting their contribution to the Performance Model Score. We evaluated the models based on Error rate (the degree to which the model's predictions deviated from the actual Performance Model scores) and R^2 Score (the proportion of variance in the dependent variable that is explained by the independent variables). We selected the best-performing model based on these criteria, favoring models that assigned meaningful weights to most metrics.

Weight Assignment

To determine the weighting of metrics, we looked at the coefficients of each metric in the regression model. Metrics with higher regression coefficients were assigned higher weight. However, the weighting varied between models (i.e., with the choice of dependent variable) and so the weights were ultimately only a guide; the final decision concerning weights was based on the team's experience.

The regression models run with all metrics provided an indication of the most significant metrics overall, and the relative weight of metrics within each sub-factor.

Once we had obtained weights for all individual metrics, we performed another round of regression analysis. This time, we used the Performance Model as the dependent variable and all the sub-factor scores as independent variables. The result was a set of regression coefficients for each sub-factor. The regression coefficients from this final model were used to assign weights to each sub-factor.

Based on the methodology, the final weights for each sub-factor were assigned as follows:

Innovation Potential weights by Sub-Factor

- **Business Foundation: 30%**
  - Rule of Law Index - Regulatory enforcement
  - WGI: Regulatory quality
  - Risk of state appropriation
- **Knowledge and R&D: 20%**
  - GERD
  - Total patent applications
  - Industrial design registrations
  - Science and engineering journal articles
- **Talent (Skills & Attitudes): 20%**
  - Number of STEM researchers per million
  - GEM - Intrapreneurship Data
  - English proficiency score
- **Market Access and Corporate Fabric: 15%**
  - Digital skills among population
  - GDP growth
  - GDP nominal
  - Companies based on Forbes 2000 by GDP
- **Infrastructure & Support: 15%**
  - ICT Development Index (IDI)

Startup Ecosystems Performance weights by Sub-Factor

- **Performance: 40%**
  - Ecosystem Value by GDP
  - Count of exits over $50M by GDP
  - Count of exits over $1B by GDP
  - LSF amount by GDP
  - Number of unicorns by GDP
- **Funding: 35%**
  - Number of early-stage funding by population
  - Amount of early-stage funding by GDP
  - Number of new active VCs
  - Number of VCs with exits
- **Talent (Experience): 15%**
  - Github developers
  - Startup experience (number of Series A rounds by population)
  - Scaleup experience (exits over $50M)
- **Global Reach: 5%**
  - GC: Inbound Score
  - GMR: Outbound Score
- **Programming: 5%**
  - Number of accelerators and incubators

Policy Score:

- Employee stock options (ESOPs)
- Visa
- Fund-of-Funds by GDP
- Early-stage investor support (individual relief)
- Soft-landing program

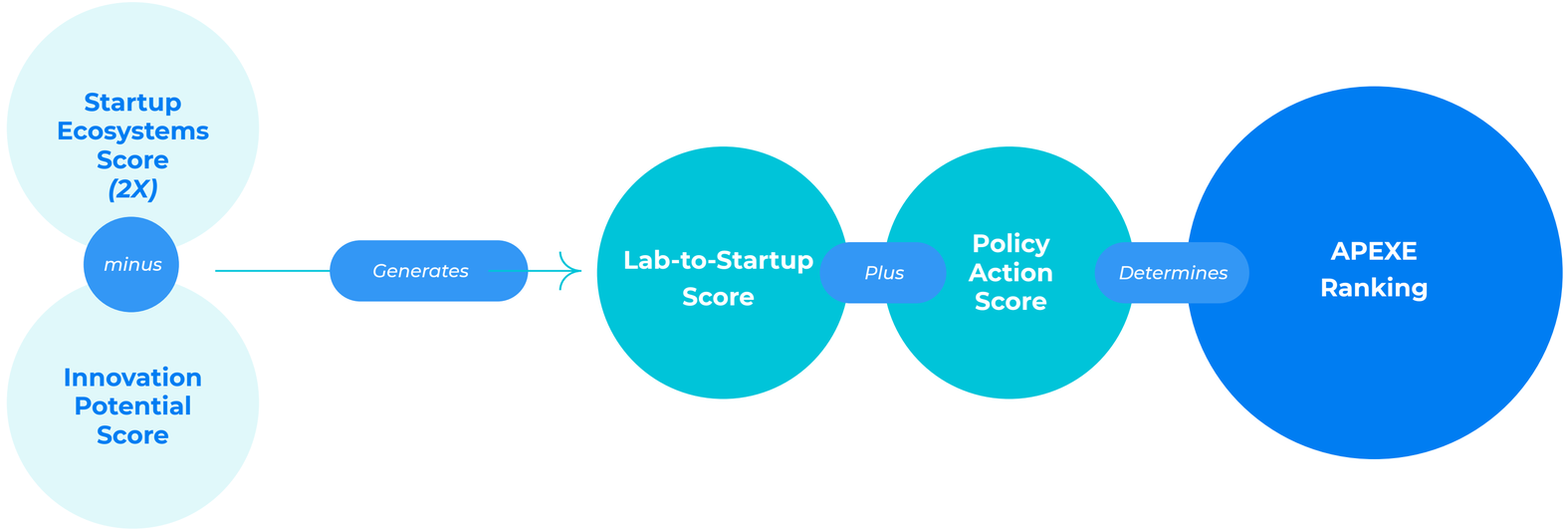
Assembling the Components

To compile the APEXE Report, we use the weighted metrics to determine the sub-factor scores, and the weighted sub-factor scores are used to determine the Factor scores.

To assemble the final ranking, we took a multiple of the Startup Ecosystem Score and subtracted the Innovation Potential score, to provide the Lab-to-Startup score. We then took a multiple of the Lab-to-Startup score and added the Policy score, to produce the APEXE score, on which countries were ranked.

Note that most of the methodological steps, including the correlation and regression analysis, was undertaken with as large a dataset as possible, including data from non-G20 countries. This was done in order to increase the power of the analysis. Non-G20 countries were removed at the final stage when the G20 ranking was produced.

Conceptual View of the APEXE Report



Component Metrics Within the Index

METRIC	SOURCE	NOTES
POLICIES		
STARTUP RELEVANT POLICY ACTION		
Fund-of-Funds	Own data from interviews & secondary research	Normalized by GDP
Early-Stage Investor Support (individual relief)	Own data from interviews & secondary research	Rated using own methodology, for scope, rate, & generosity
Visas	Own data from interviews & secondary research	Presence or absence of specific visa scheme for entrepreneurs
ESOPs	Own data from interviews & secondary research	Rated using own methodology, for scope & timing of taxation
Attraction Initiatives	Own data from interviews & secondary research	Rated using own methodology
Global Reach Support (soft-landing)	Own data from interviews & secondary research	Rated using own methodology
STARTUP ECOSYSTEM		
FUNDING		
Count of New Active VCs	SG data based on Dealroom, Pitchbook, and Crunchbase	
Count of VCs with Exits	SG data based on Dealroom, Pitchbook, and Crunchbase	
Early-Stage Funding Count	SG data based on Dealroom, Pitchbook, and Crunchbase	Normalized by population
Early-Stage Funding Amount	SG data based on Dealroom, Pitchbook, and Crunchbase	Normalized by GDP

CONTD.

METRIC	SOURCE	NOTES
GLOBAL MARKET REACH		
GMR: Outbound Secondary Offices	SG data based on Dealroom, Pitchbook, and Crunchbase	
GC: Inbound Secondary Offices	SG data based on Dealroom, Pitchbook, and Crunchbase	Log of count
PROGRAMS		
Number of Accelerators & Incubators	Dealroom, Pitchbook, and Crunchbase	Log of count
TALENT (EXPERIENCE)		
Scaleup Experience (Exits over $50M, 2014-2023)	SG data based on Dealroom, Pitchbook, and Crunchbase	
Startup Experience (Series A Rounds 2014-2023)	SG data based on Dealroom, Pitchbook, and Crunchbase	Normalized by population
Top Github Developers	SG analysis of Github data	Calculated by identifying developers or contributors on GitHub with the highest number of contributions, stars, followers, or impactful projects
PERFORMANCE		
Exits over $50M H2 2021-2023	SG data based on Dealroom, Pitchbook, and Crunchbase	Normalized by GDP
Exits over $1B H2 2021-2023	SG data based on Dealroom, Pitchbook, and Crunchbase	Normalized by GDP
Ecosystem Value	SG data based on Dealroom, Pitchbook, and Crunchbase	Normalized by GDP

CONTD.

METRIC	SOURCE	NOTES
Late-Stage Funding Amount	SG data based on Dealroom, Pitchbook, and Crunchbase	Normalized by GDP
Number of unicorns, companies over $1B valuation	SG data based on Dealroom, Pitchbook, and Crunchbase	Normalized by GDP
INNOVATION POTENTIAL		
BUSINESS FOUNDATIONS		
Rule of Law Index - Regulatory Enforcement	World Justice Project	No normalization needed
Risk of State Appropriation	Credendo	No normalization needed
Regulatory Quality	World Bank, Worldwide Governance Indicators	No normalization needed
TALENT (SKILLS & ATTITUDES)		
Rates of Intrapreneurship	Global Entrepreneurship Monitor	No normalization needed
Count of STEM Researchers	UNESCO	Normalized by population
English Proficiency Score - Country Level	EF English Proficiency Index	No normalization needed
INFRASTRUCTURE & SUPPORT		
ICT Development Index (IDI)	International Telecommunication Union (ITU)	No normalization needed

CONTD.

METRIC	SOURCE	NOTES
KNOWLEDGE AND R&D		
GERD (as % of GDP)	OECD Main Science and Technology Indicators	Already normalized by GDP
Total Patent Applications	WIPO	Normalized by population. PCT applications as more indicative of quality
Industrial Design Registrations	WIPO	Normalized by GDP
Science and Engineering Journal Articles	World Bank	Normalized by GDP
MARKET ACCESS AND CORPORATE FABRIC		
GDP Per Capita (PPP, 2022)	World Bank	Already normalized by population
Digital Skills Among Population	World Bank	No normalization needed
GDP Growth (annual %)	World Bank	No normalization needed
Presence of Large Firms	Forbes Global 2000	Normalized by GDP

Acknowledgements

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Acknowledgements

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Image Credits

The cover features Brazil. As the host of the 2024 Group of Twenty (G20) summit, Brazil has positioned itself as a key global leader In recent years, Brazil's startup ecosystem has flourished, with São Paulo ranking as top 30 global startup ecosystem and producing more than a dozen active unicorns.

All images taken from Unsplash.

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Silicon Valley serial entrepreneur and Founder & CEO of Startup Genome, JF is the world's leading voice in innovation ecosystem development, having advised more than 100 governments and agencies across 50 countries. He has founded five businesses and led other across two continents and three sectors (Tech, Life Sciences, and Cleantech). He is an angel investor and previously worked in corporate innovation, advising several of the world's largest tech companies.

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Marc leads global growth and impact. He advises governments, scientific organizations and venture backed startups alike and is an appointed Expert in Entrepreneurship, IT and Future of Economic Progress by the World Economic Forum.

Prior to founding Startup Genome, he co-led the startup ecosystem development unit at Silicon Valley-based Startup Compass (acquired by Sage). At PwC, KPMG, and Bayer Group's internal management consultancy, Marc advised business executives across various sectors. He also founded a nonprofit organization to catalyze social innovation.

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Stephan works with clients in government and private industry consortia all around the world, advising on the creation and the acceleration of tech and innovation clusters. Prior to his role at Startup Genome, Stephan headed up the International Consulting practice at UK ecosystem agency Tech Nation (fka Tech City UK) in London and served as Managing Director of digitalswitzerland. Previous to his work in the digital ecosystems space, Stephan worked as an executive director for professional services firms Arthur Andersen and Ernst & Young.

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Parshant has been in data analysis for the past 10 years, six of which have been in Startup Genome's Data Science team. He leads the team responsible for quantitative data infrastructure and analysis, including data on over three million companies, 280+ ecosystems, and survey data from more than 100,000 startup executives across the globe.

GLOBAL ENTREPRENEURSHIP NETWORK (GEN)

Jonathan Ortmans
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Founder and president of the Global Entrepreneurship Network, working to foster healthier local entrepreneurship ecosystems in more than 170 countries while connecting them into one global ecosystem. In 2008, he launched GEN's cornerstone initiative, Global Entrepreneurship Week, enabling millions of people to explore their potential through thousands of local GEW activities and competitions each November. Through building GEW, Ortmans assembled a broad multi-disciplinary coalition that is the backbone of GEN operations, including entrepreneurs, investors, policymakers, researchers and affiliated support organizations. He serves as a longtime advisor to the Kauffman Foundation and chairs the Global Entrepreneurship Congress.

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APEXE NATIONS REPORT