Jordan Semiconductors Feasibility

Commissioned by IFC - a member of the World Bank Group

Global & regional competitiveness analysis

June 2024

IBM **Consulting**
Plant Location International

IFC International Finance Corporation WORLD BANK GROUP

Table of contents

Introduction

- The objective of this competitiveness analysis is to assess Jordan's competitive position for a back-end semiconductor facility and to identify the country's key strengths and weaknesses along the lines of the key drivers for an investment and location decision in this segment.
- Firstly, a representative prototype investment project profile was developed for a semiconductor assembly, packaging and testing facility, with project assumptions, location requirements and weightings.
- Then, a data gathering process has been launched for the identified location requirements. This process simulates the approach that IBM-PLI applies for our corporate location analysis, and thus uses the same type of data and sources that a private investor would be looking at when screening countries or regions for their location decisions.
- Using the data collected, locations are rated or benchmarked against each investment criterion that was identified to derive a weighted score. A financial (cost) / profitability analysis also assesses the major location-sensitive operating costs in each location.
- The qualitative and quantitative results are then reported in a so-called Cost-Quality Map clearly showing the trade-off between costs/profitability and quality factors.
- Finally, the comparative cost and quality assessment allows for the identification of Jordan's relative competitive strengths and weaknesses, as well as those of its main competitors.

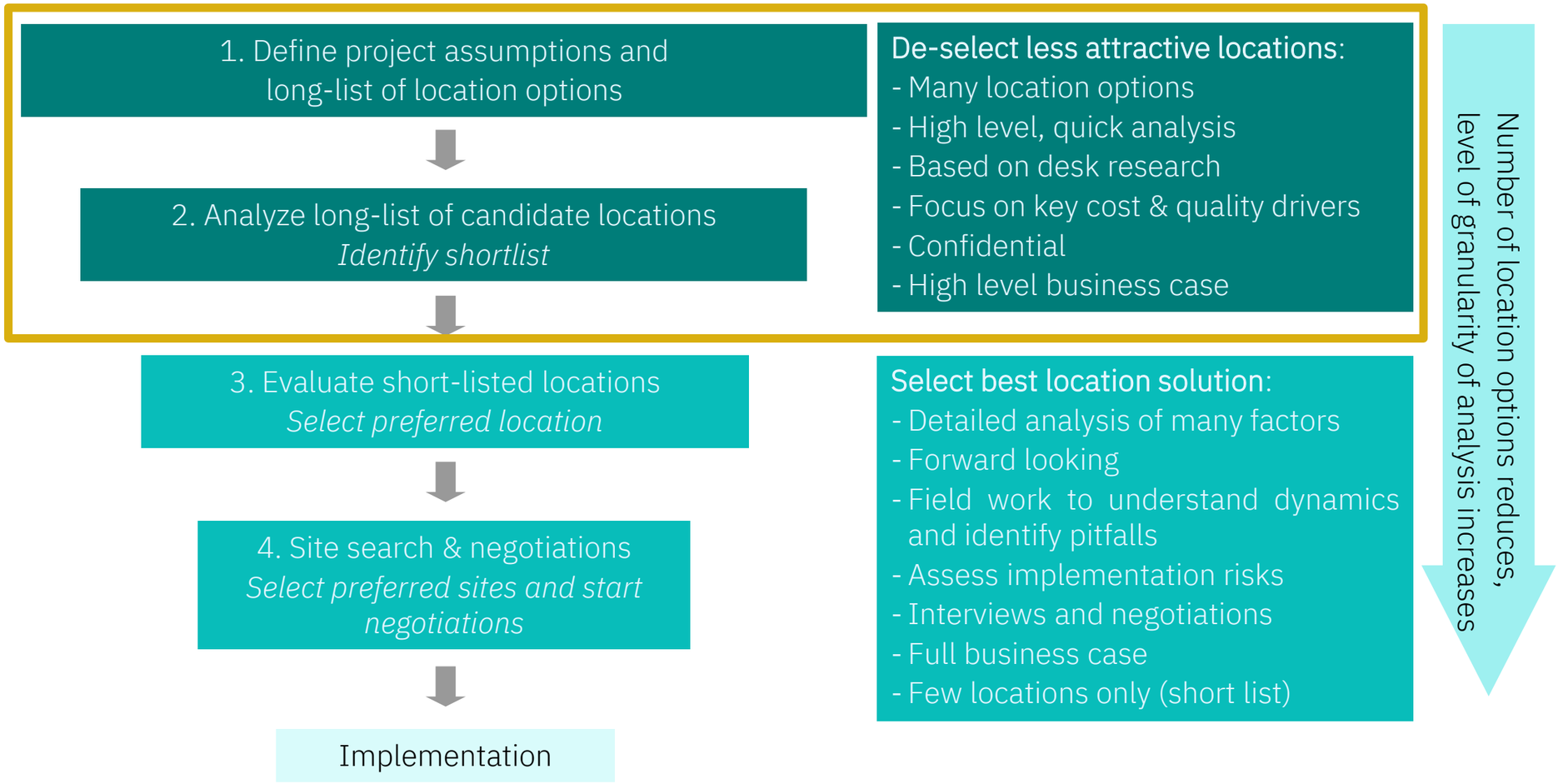
Competitor locations

The competitive regions (max. 10) included in the competitiveness analysis exercise as an outcome of Step 1 are listed below.

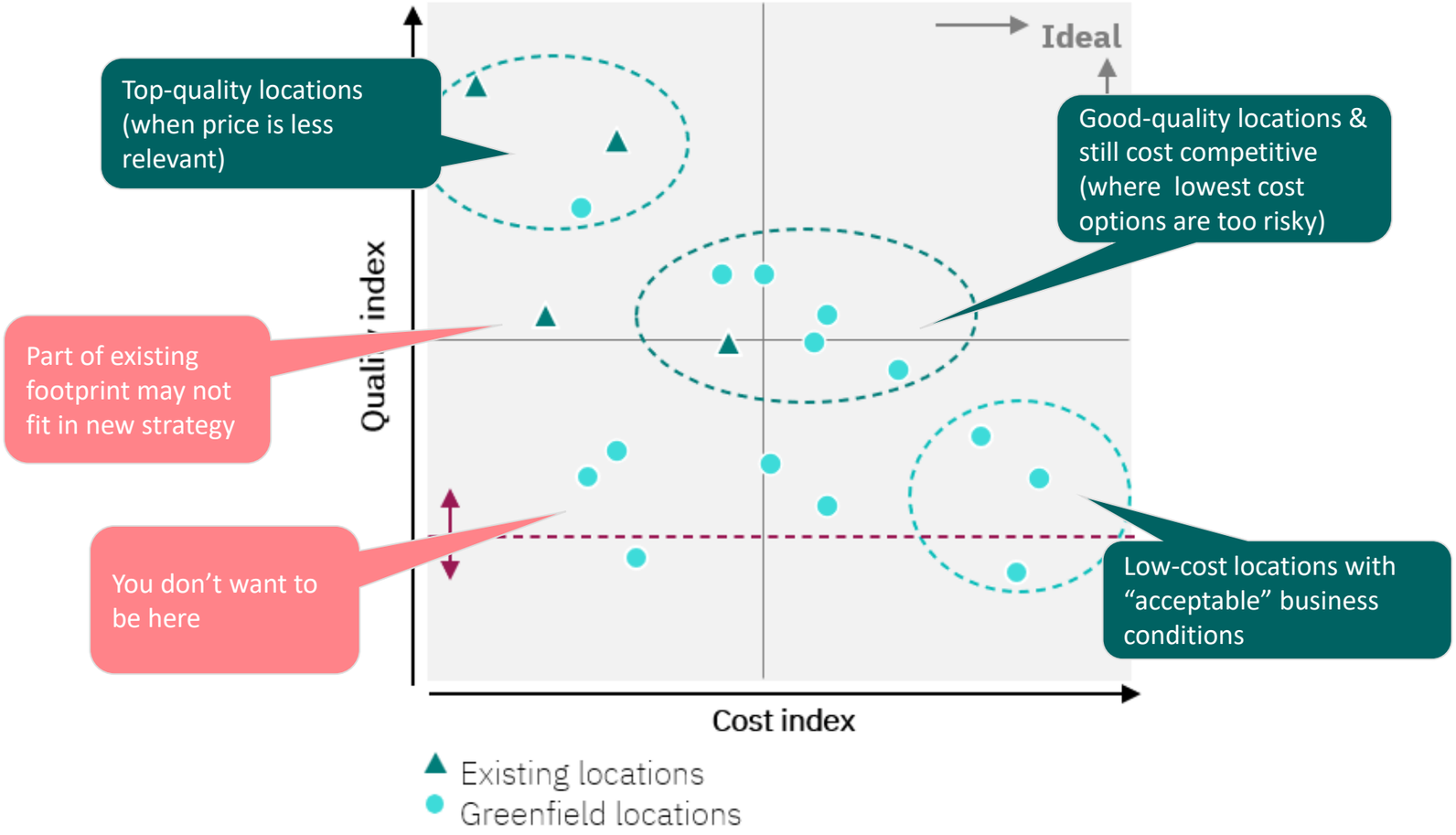
Geo	Country	Reference location (labor drawing area)	Rationale
	Jordan	Amman	
Regional	Egypt	Cairo	Generic regional competitor
	Hungary	Budapest	Key regional competitor
	Israel	Tel Aviv	Key regional competitor
	Poland	Wroclaw	Key regional competitor
	Saudi Arabia	Dammam	Generic regional competitor
	United Arab Emirates	Dubai	Generic regional competitor
Global	China	Suzhou	Established global hub and competitor
	India	Ahmedabad	Key emerging global competitor
	Malaysia	Penang	Key global competitor
	Mexico	Guadalajara	Key emerging global competitor

Table of contents

Our approach to competitive positioning follows the initial steps of corporate location decision making process to ensure a realistic investor perspective



The key output of the competitive positioning is a cost-quality trade-off demonstrating the types of value propositions that exist



Approach to defining an investment prototype & associated corporate investment location criteria

In our competitiveness assessment we have analyzed Jordan's competitive position as it is typically assessed during the initial stages of a corporate location selection process, when companies are analyzing a long-list of locations with the objective to select a short-list of best candidate locations based on their specific requirements.

We have developed a profile of a representative semiconductor assembly, test and packaging (ATP) investment project, setting out the key qualitative location drivers ('Location criteria') and their relative weights, coupled with a set of cost assumptions ('Investment Profile') used in the location benchmarking process. The profile assumptions are based on IBM-PLI project experience working with corporate location decision makers, supplemented with consultations with industry experts and with our in-house Global Electronics Center of Competence.

The project profile is then used to simulate a real corporate investment location decision, and to benchmark Jordan against a selection of competitor locations on qualitative and cost/profitability requirements.

Sources used

The location benchmarking analysis is based on the most recently available data from internationally recognized, credible and reliable sources, as well as data obtained from local sources such as national statistical offices and investment promotion agencies with a key focus on those data sources that an investor would typically analyze when performing an initial screening of possible locations. Preference is given to data sources that allow international apples-to-apples comparison between global locations.

Typical secondary data sources that we will use include:

- ✓ Renown external providers of international data sources: AON, CIA, IEA, Ernst & Young, Eurostat, ILO, IMD, IMF, Manpower, OECD, Willis Towers Watson, Transparency International, UNESCO, World Bank, World Economic Forum, WTO, etc.
- ✓ Industry associations, business directories, such as LinkedIn Premium, D&B Hoovers, etc. to assess access to specific skill pools and presence of industry clusters
- ✓ Official national, regional and local statistical sources

In addition, we rely on various internal information sources:

- ✓ Moody's/IBM-PLI – Orbis Crossborder Investment / Global Location Trends database database with detailed information on recent greenfield investment projects around the world, currently containing more than 200,000 FDI projects
- ✓ IBM-PLI's extensive project experience, particularly for more intangible factors
- ✓ IBM's own operations and its consulting practices in the selected countries

Table of contents

Investment profile

Setting out the key requirements of the investment project

On the basis of below assumptions, a financial analysis has been carried out, using local cost data for each location (labor, utilities, transport, duties).

Project assumptions		
Annual Sales	450,000,000	USD
Discount rate	10%	
OPERATING REQUIREMENTS		
Total headcount	1992	FTE
Profiles		
Site manager	2	FTE
Technical Systems Engineer	100	FTE
Materials / Chemicals specialist	50	FTE
Maintenance/equipment technician	160	FTE
Software/application developer	80	FTE
Process engineer	100	FTE
Production Supervisor	100	FTE
Engineering / Process Operative	400	FTE
Production Operative: highly skilled	1000	FTE
Power consumption	100	GWh
Power capacity	10	MW
Water consumption	750,000	m^3
Input materials	247,500,000	USD
Building	100,000	m^2

Market s served	% of output
European Union	50%
North America	25%
China	25%

INVESTMENT REQUIREMENTS		
Industrial land		
Total sqm required	16	ha
Investment in buildings	150,000,000	USD
Investment in equipment	400,000,000	USD

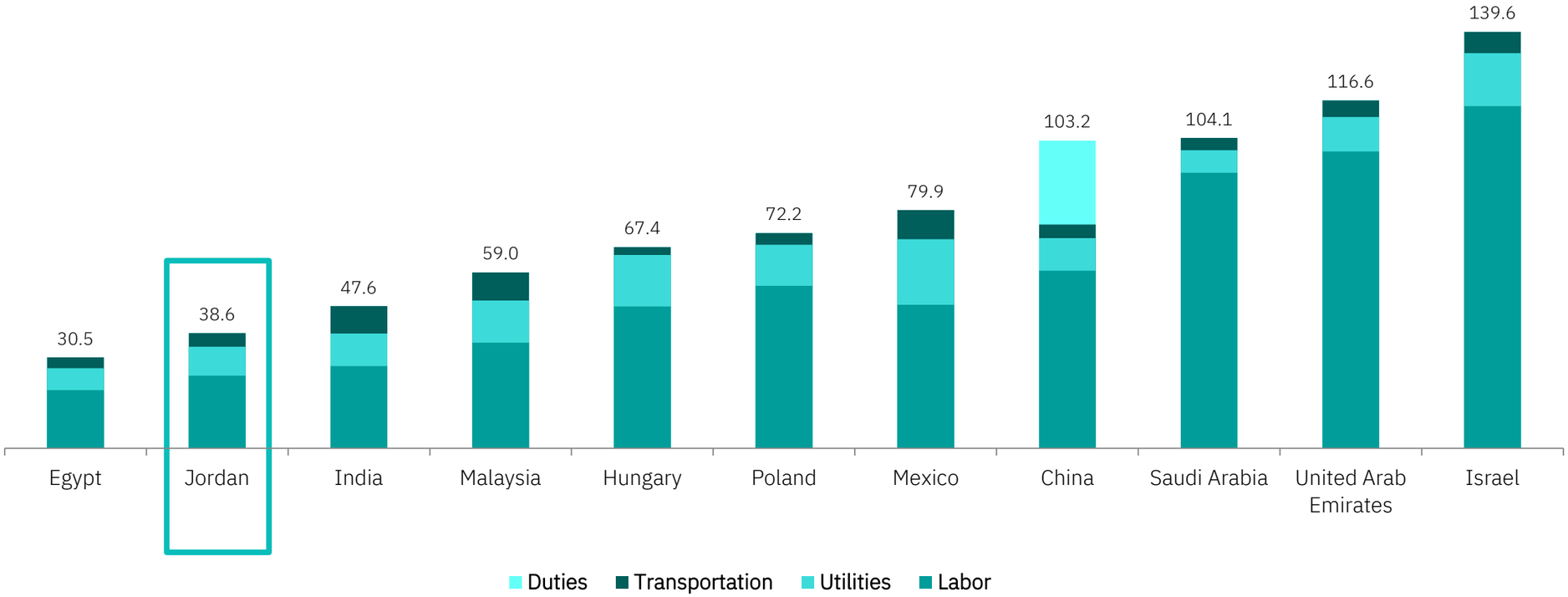
Operating costs

comparison for all locations; in million USD;
Year 1

Note: a lower operating cost positively impacts a location's proposition

- Labor costs are based on gross annual wages and social security contributions.
- Utility costs are based on internationally comparable rates for industrial users.
- Transport costs take into account relevant point-to-point commercial rates as required under the market assumptions in the project profile.

Operating costs in Jordan are competitive across all three major cost components with only Egypt offering a lower cost profile.



Profitability index

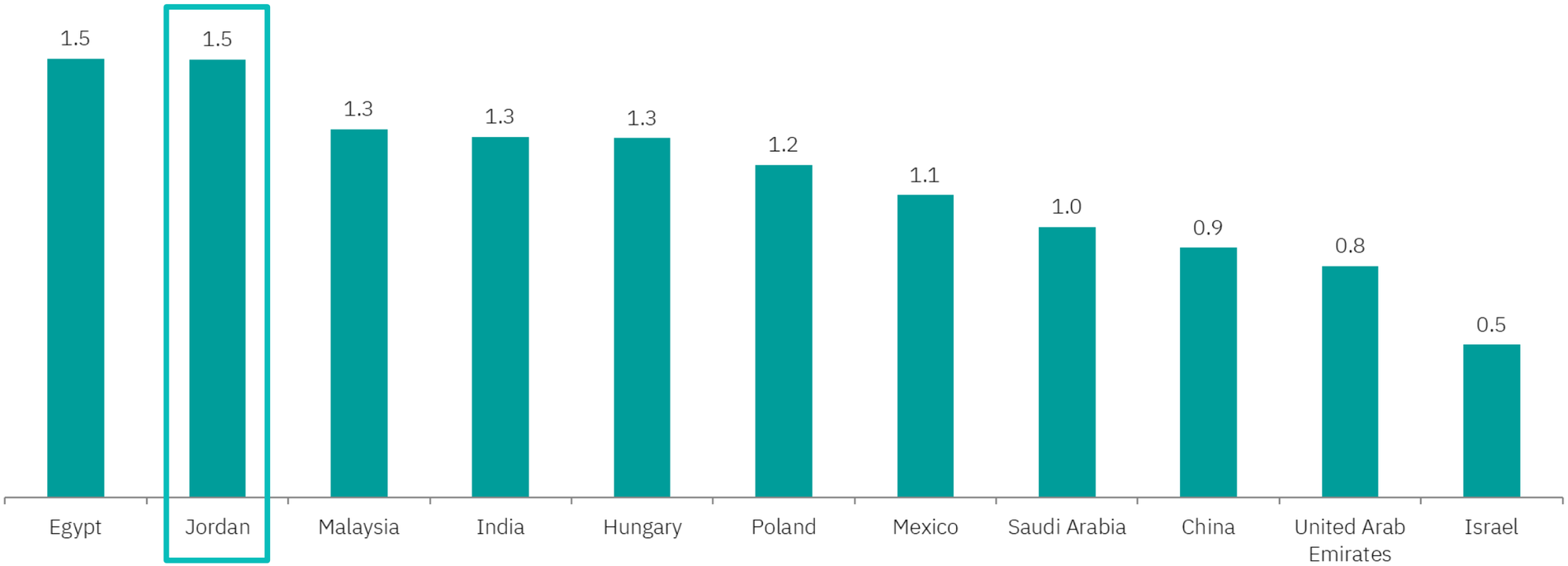
comparison for all locations

Note: a higher profitability index positively impacts a location's proposition

Profitability assessment based on the present value (PV) of 10-year cash flows and required investment expressed as a PI - profitability index (discounted cash flows versus investment with a value >1 indicating a profitable/feasible investment)

This multiyear calculation includes an assessment of the impact of forecasted wage growth as well as the impact of corporate taxation.

Overall profitability is the highest in Jordan (with Egypt at the same level), followed by Hungary, India and Malaysia. Profitability in China, Israel, Saudi Arabia and UAE are below the overall level of feasibility (i.e. PI<1) which in the case of China is explained entirely by US import duties.



Location criteria

Setting out the key location selection criteria (non-cost factors) and their relative importance for the investment project as derived from corporate experience

On the basis of these criteria, weights and underlying data, a sector and project specific qualitative analysis has been carried out for each location.

Location category	Weight (%)	Location factor	Weight (%)	
General business environment	18	Economic & financial stability	20	4%
		Political stability	20	4%
		Natural disaster risk	20	4%
		Quality of government support	20	4%
		Availability of financial support for setting up	20	4%
Regulations	18	Working time regulations	15	3%
		Hiring & firing flexibility	15	3%
		Business permitting	25	5%
		In- & outbound restrictions and customs	25	5%
		IP protection & cybersecurity	20	4%
Market	10	Regional/global market access	50	5%
		Access to relevant supply base	50	5%
Talent	18	Presence of experienced staff	45	8%
		Presence of non-experienced staff	25	5%
		Competition for staff	30	5%
Sector specialization	6	Presence of relevant industry base	40	2%
		Presence of logistics services providers	60	4%
Infrastructure & connectivity	25	Air access	30	8%
		Regional transportation network	15	4%
		Reliability of power supply	25	6%
		Water supply	10	3%
		Energy sustainability potential	20	5%
Living environment	5	Quality of living environment	100	5%
Total	*100*			*100%*

Location criteria

Overview of main data points and sources used for our informed scoring method - translating facts & figures into relative comparative assessments across the set of evaluated locations

Location factor	Data points	Main international sources (in addition to local statistics)
Economic & financial stability	GDP per capita/growth, inflation, public debt, current account balance, FX stability	IMF WEO, IMD, EY, CIA Factbook
Political stability	Political risk & rule of law	AON, World governance indicators, IMD, EIU
Natural disaster risk	Natural hazards risk and exposure	INFORM Risk Index
Quality of government support	Government effectiveness, corruption, regulatory quality	Worldwide Governance Indicators, Transparancy International, IMD
Availability of financial support for setting up	Availability of incentices, tax rates	EY, IMD
Working time regulations	Holidays, overtime, night work	Worldbank, Doing Business
Hiring & firing flexibility	Fixed term contracts, notice period, severance pay	Worldbank, Doing Business
Business permitting	Starting a business, registering property, land administration, bureaucracy	Worldbank, Doing Business, IMD
In- & outbound restrictions and customs	Trading across borders, customs procedures	Worldwide Governance Indicators, Doing Business, WEF
IP protection & cybersecurity	IP protection, cybersecurity	Property Rights Alliance, National Cyber Security Index
Regional/global market access	Trade agreements, flight connections and travel time to defined markets	WTO, EU Market Access, Skyscanner
Access to relevant supply base	Access to consumables (turnover); substrate, wafers (flight connections and travel time)	D&B Hoovers, Skyscanner
Presence of experienced staff	Material science, electrical engineering, mechanical engineering, electro-mechanics, process engineering/operators	D&B Hoovers, UNIDO, IBM-PLI GLT database, LinkedIn, IMD
Presence of non-experienced staff	Tertiary students, students in engineering/ICT, skillset of graduates	UNESCO, IMD, WEF
Competition for staff	Unemployment, skills shortage	Manpower, IMD
Presence of relevant industry base	Electronics/electrical/semiconductors industry base and investment	D&B Hoovers, UNIDO, IBM-PLI GLT database
Presence of logistics services providers	Logistics industry base and investment	D&B Hoovers, IBM-PLI GLT database
Air access	Quality of air transport infrastructure, number of passengers/cargo	WEF, IMD
Regional transportation network	Quality and density of road/rail networks	WEF, IMD, CIA Factbook
Reliability of power supply	Quality of supply, outages, generation capacity	WEF, World Development Indicators, IMD
Water supply	Water resources / access	IMD
Energy sustainability potential	Share of renewables, ability to access renewable energy as a	IEA, World Development Indicators, RISE
Quality of living environment	Quality of life, safety, tourist presence	Social Progress imperative, World Development Indicators, COIS, Numbeo

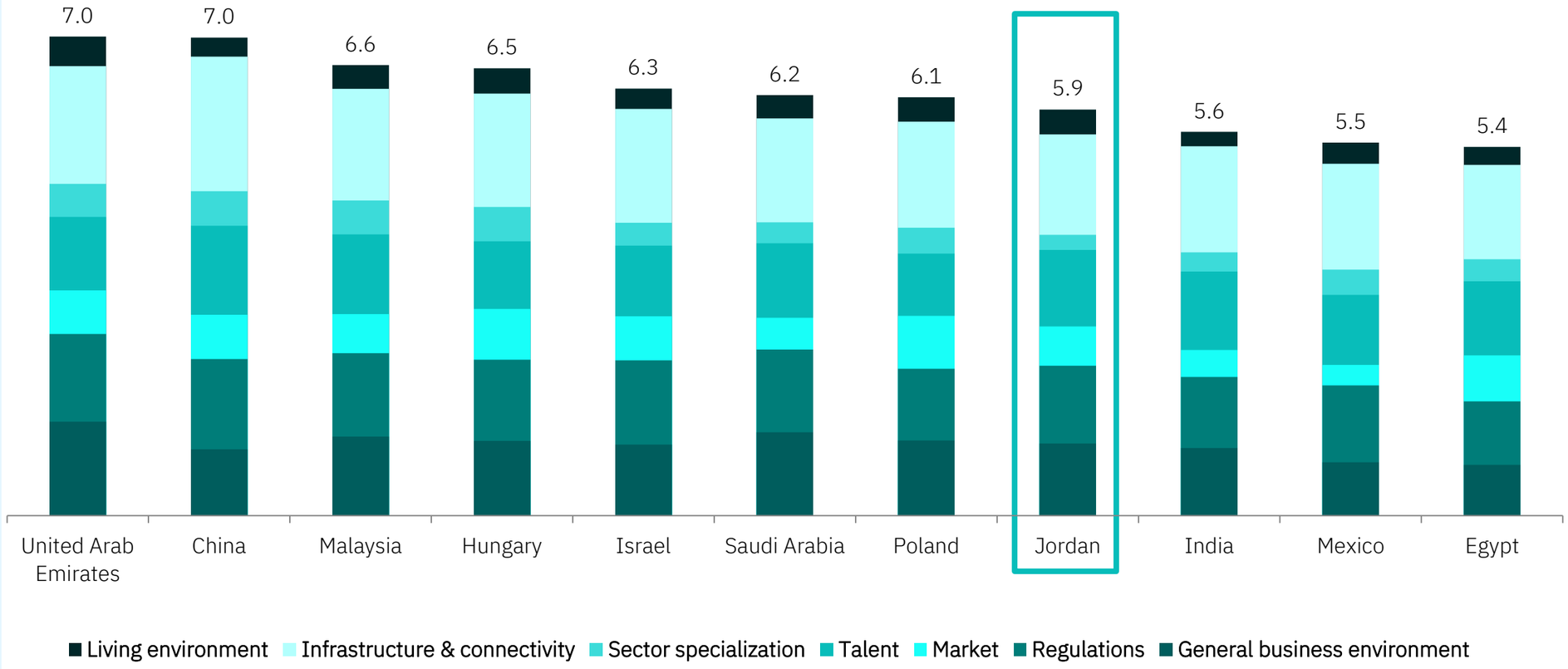
Quality assessment

Using the individual scores and weights per factor, an overall weighted qualitative comparison for all locations is calculated

Note: a higher score is better

Weighted quality scores range from 0-10 with 10 representing highest operational quality. The scores reflect the weight of each category's underlying location factors combined with each location's performance on those factors.

A few locations stand out from a quality point of view, most notably China, UAE, Hungary and Malaysia. The performance of Jordan is intermediate but clearly above the level of key competitors including India, Mexico and Egypt.



Scoring heat map

The individual scores can be further evaluated by means of a heat map

Note: a high score & green shade is best

Location factor	United Arab Emirates	China	Malaysia	Hungary	Israel	Saudi Arabia	Poland	Jordan	India	Mexico	Egypt
Economic & financial stability	9	7	8	4	6	8	5	6	7	6	4
Political stability	8	6	7	7	4	6	7	6	5	4	3
Natural disaster risk	7	2	5	6	6	8	7	6	2	3	5
Quality of government support	7	5	6	5	7	6	5	5	5	4	3
Availability of financial support for setting up	8	7	6	7	6	5	6	6	8	4	4
Working time regulations	6	7	7	6	6	6	6	6	5	6	7
Hiring & firing flexibility	8	7	7	7	7	6	6	7	8	6	5
Business permitting	8	7	6	7	6	7	4	6	4	5	4
In- & outbound restrictions and customs	8	9	8	7	8	8	7	7	8	9	6
IP protection & cybersecurity	5	6	7	6	7	6	7	6	6	5	5
Regional/global market access	5	6	5	8	7	4	7	6	3	4	7
Access to relevant supply base	8	7	6	7	6	6	8	5	5	2	7
Presence of experienced staff	6	8	7	6	6	6	6	5	7	6	6
Presence of non-experienced staff	7	8	8	7	7	8	5	7	8	6	7
Competition for staff	5	5	4	4	4	5	4	7	5	5	5
Presence of relevant industry base	7	10	10	8	7	3	5	4	3	6	5
Presence of logistics services providers	9	8	7	8	4	7	7	4	6	7	5
Air access	9	8	7	7	7	7	6	6	5	7	7
Regional transportation network	8	7	6	7	7	6	7	5	6	6	6
Reliability of power supply	8	8	6	5	8	9	6	6	5	5	4
Water supply	5	8	9	7	6	6	7	5	6	6	5
Energy sustainability potential	2	8	5	7	4	1	5	7	9	7	5
Quality of living environment	9	6	7	7	6	7	7	7	4	6	5
Total weighted score	7.0	7.0	6.6	6.5	6.3	6.2	6.1	5.9	5.6	5.5	5.4

best (score 10) — worst (score 0)

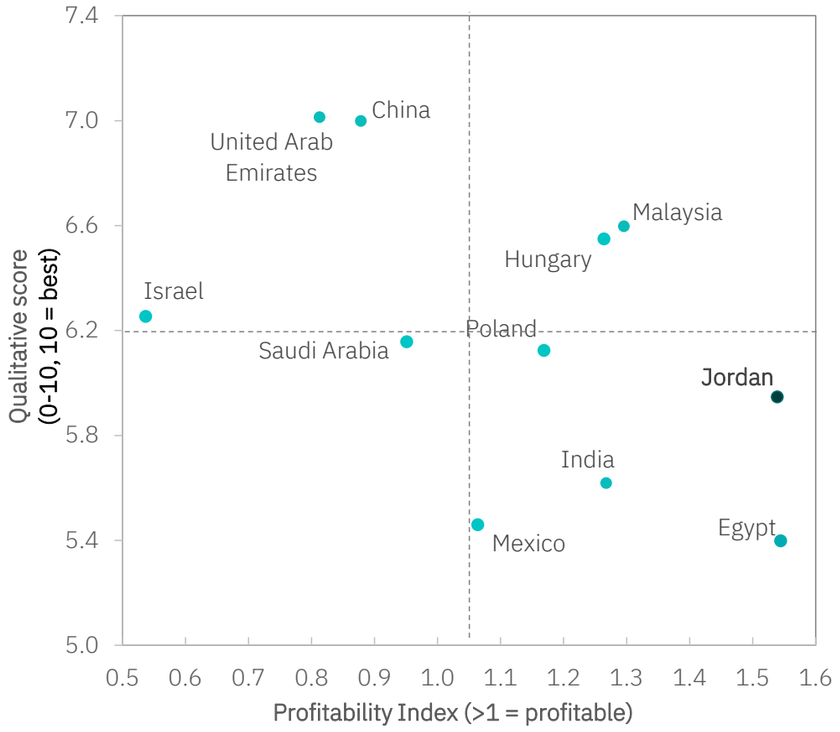
Cost- quality map

Jordan's competitive position

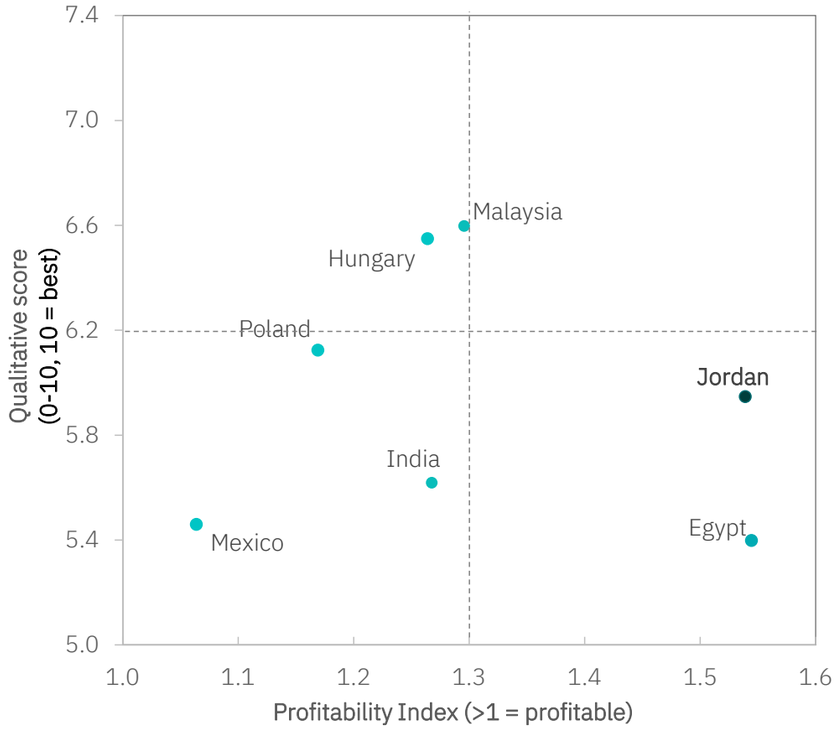
Note: for an ATP facility the top right quadrant is expected to be the most favorable for short list selection

Jordan combines the highest profitability among all locations assessed with a stronger / lower risk operating environment compared to a number of key competitors.

When the focus is purely on locations offering a favorable profitability, Jordan becomes a realistic option for short list selection. Key competitors include Hungary/Malaysia as well as Egypt.



Locations with PI<1 excluded

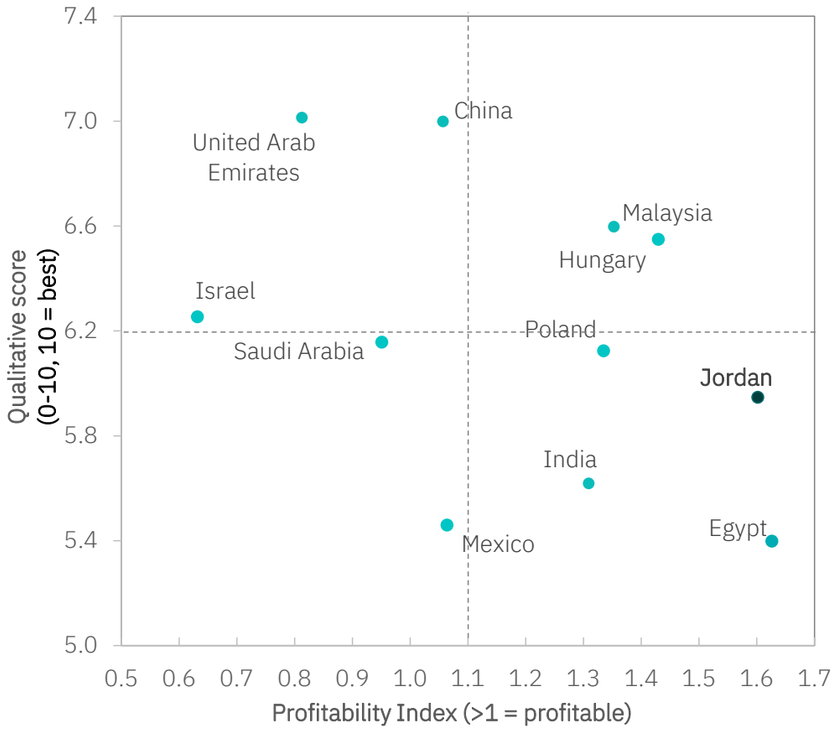


Cost- quality map with incentives estimate

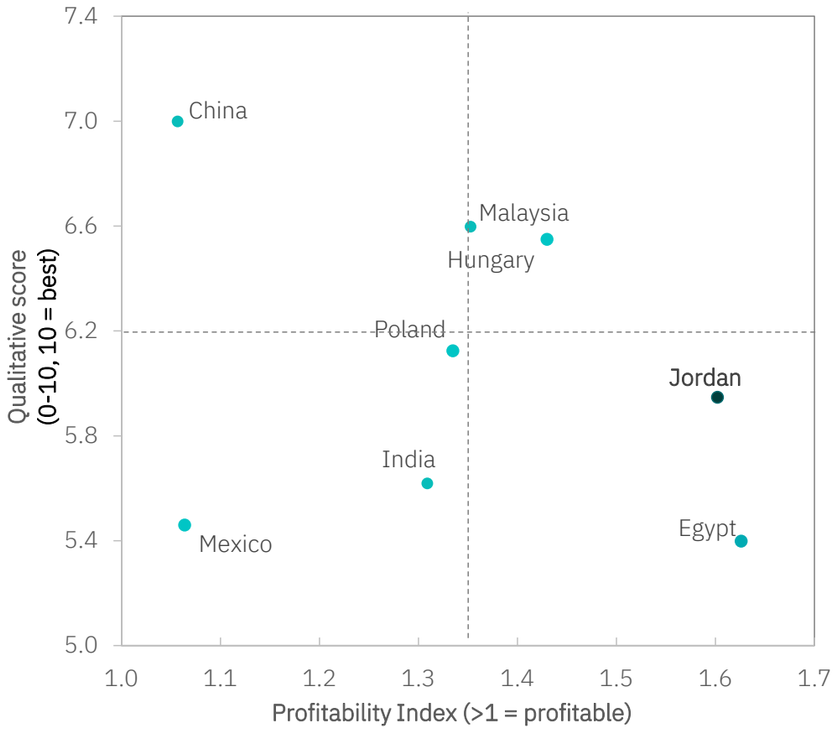
Jordan's competitive position

Note: for an ATP facility the top right quadrant is expected to be the most favorable for short list selection

When an indication of potential investment incentives is included, China clearly becomes a competitive option, and also Malaysia and Hungary improve their proposition. Nevertheless, Jordan's overall proposition remains similar with a high profitability (broadly similar to Egypt). Except for Poland becoming a stronger candidate, the main competitors do not change compared to the scenario without incentives.



Locations with PI<1 excluded



Jordan’s value proposition

Jordan’s value proposition

Jordan combines the highest profitability among all locations assessed with a stronger / lower risk operating environment compared to a number of key competitors. Given the strong drive of the Jordanian government to work closely with investors to alleviate some of the key operational weaknesses identified, Jordan is well placed as a promising destination for investment in an ATP facility.

Major competitive strengths	Key weaknesses
▪ Good availability of qualified engineers ▪ Large pool of STEM graduates, receiving above average quality of education ▪ Lowest competition for skills / skill shortage among all locations assessed ▪ Highly competitive labor, utility and transportation costs resulting in highest profitability ▪ Safe and stable operating environment with limited natural disaster risk ▪ Relatively supportive regulatory environment especially in the areas of labor market and cross border trade ▪ Good market access with proximity to EU and FTA’s with US and EU ▪ Strong energy sustainability potential ▪ Attractive and safe living environment	▪ Smallest pool of talent with relevant experience ▪ Below average access to relevant suppliers ▪ Limited presence of the electronics/semiconductor industry ▪ Less established logistics services cluster and below average air connectivity ▪ Less comprehensive cybersecurity measures ▪ Water supply limitations

Jordan's competitive counter-arguments

Identified weakness in Jordan's competitive proposition	Counterargument
Smallest pool of talent with relevant experience	The skill pool is assessed to be sufficiently large to host the modelled ATP facility with good availability of qualified engineers as well as strong presence of process manufacturing skills. Moreover, Jordan offers the lowest competition for skills / technical skill shortages among all locations assessed which provides an answer to the currently most important global semiconductor industry challenge. Finally, technical, vocational and higher education institutions are actively realigning their programs with employer needs in electronics/semiconductor manufacturing.
Below average access to relevant suppliers	Local electronics/electrical manufacturing companies have experience with substantial localization of their supplies (plastics, metals, consumables). Plus potential to improve air connections with key supplier origin locations based on specific investor needs.
Limited presence of electronics/semi-conductor industry	Various players with electronics/electrical manufacturing knowledge and expertise are successfully operating in Jordan. Moreover, also Egypt, India and Saudi Arabia have a below average cluster presence.

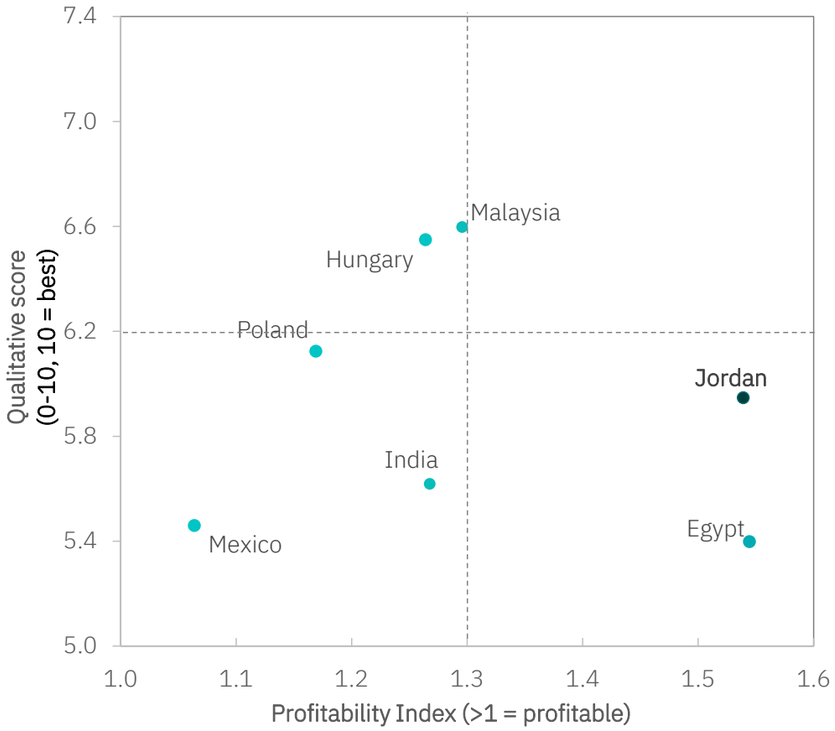
Jordan’s competitive counter-arguments

Identified weakness in Jordan’s competitive proposition	Counterargument
Less established logistics services cluster / air connectivity	Dedicated and specialized logistics services / air connections can be developed / attracted based on specific investor needs.
Less comprehensive cybersecurity measures	A revised cybersecurity law was enacted in 2023 and a national cybersecurity center created contributing to sustained improvement on this measure over the last few years.
Water supply limitations	To address water scarcity in the country, initiatives are underway to develop new sources of water. Access to industrial water is not considered a major hurdle, as illustrated by sizeable textile plants which are also large-scale users.

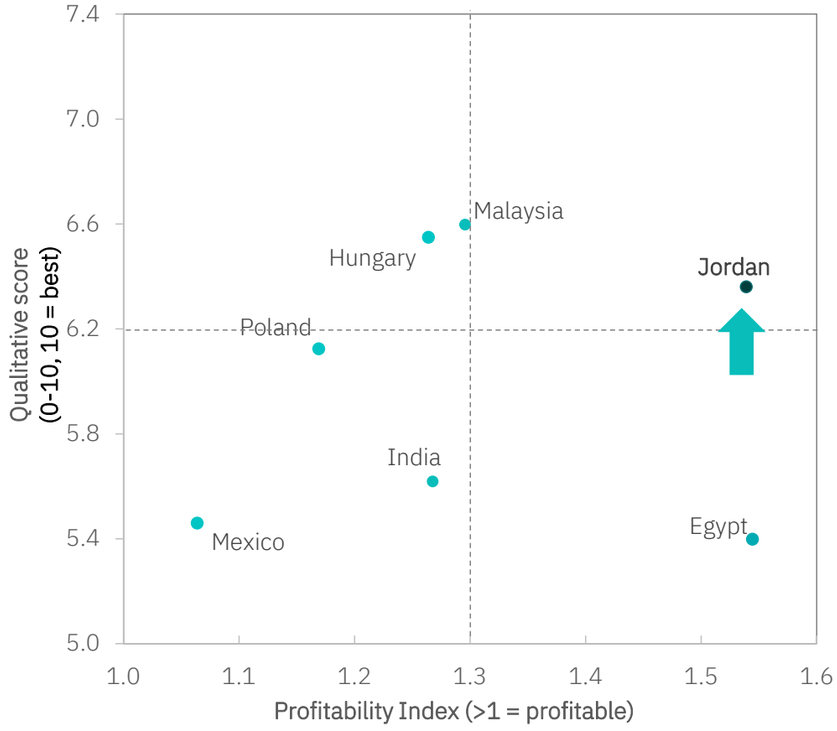
Cost- quality map – sensitivity

Jordan's competitive position, illustrating impact of business environment improvement regarding main weaknesses

Government support that would address the various weaknesses identified in Jordan's business environment (cfr. sensitivity analyses and improvement recommendations in Step 4-5) would further improve the country's position as a compelling option for a cost sensitive ATP facility.



Sensitivity based on improvement actions



Introduction to IBM-PLI

IBM-PLI
(Plant Location International)

Global Center of Competence

Location, footprint & supply chain strategies

Economic development & investment promotion advise

All geos, industries, and business functions

Country / region / city / site

60+ years experience

>3,000 projects

Robust methodologies & tools

Strategic, operational & tactical

Also supporting IBM internally

Contact us

Plant Location International (PLI)
IBM Consulting
—
Visit us on the web at
https://www.ibm.com/consulting/pli

Patsy Van Hove
Senior Manager
—
Patsy.Van.Hove@be.ibm.com
+32 475 91 57 82

Koen Gijpers
Managing Consultant
—
Koen Gijpers@be.ibm.com
+ 32 494 33 45 92