An AI-based conceptual framework for port ranking

Yanjie Zhou[a], Xiaojin Wang[a], Zehao Qian[b], Tao Li[a]

[a]*School of Management, Zhengzhou University, China, 315100, China*
[b]*Department of Nature Sciences, Durham University, UK, DH1 3LE*

Abstract

In this paper, i

Keywords:

1. Introduction

2. Port ranking

2.1. Container port

2.1.1. Seaport

Seaports are often located on the coast, facing the ocean,with deep-water channels and large dock facilities,being used for maritime cargo transportation and ship docking. Seaports also provide cargo handling, warehousing and other related services, connecting the goods flow among countries and regions. Seaports can be connected to sea and air transport to work as a part of multimodal transportation. Seaports usually have great oceanic landscapes around, and could offer various amusement facilities, which will attract large visitors to come for vacations, ensuring them convenient and comfortable experiences. So, seaports could not only develop local economy in many aspects such as tourism, manufacturing and logistics, but also provide working opportunities. However, seaports may pollute the ocean by exhausting gas from ships, discharging wastewater, litter and so on.To ensure a sustainable development and protect marine ecosystem, seaports gradually pay attention to green development by lowering bad impacts on the environment around, such as encouraging ships to use clean and new energy, exhausting gas or wastewater after treatment, building shore power facilities to attracting ships to use,establishing protected areas, etc.

2.1.2. Dry port

Dry ports are seated in inland areas, serving as cargo distribution centers, usually being far from seaports. It transports goods through railways or highways. Dry port provide similar logistics services as seaports,but it pay more attention to connecting railways and highways But dry ports are lack in the aspects of tourism and entertainment.As for developing local economy, dry ports contribute the same as seaports and river ports, but in different way.

2.1.3. River port

River ports are typically situated in inland areas,with shallow-water channels and smaller dock facilities, serving the transportation of small ships and light cargo. River ports, connecting different regions through rivers, can also serve as cargo distribution centers and tourist attractions and places for leisure.River ports facilitate trades respectively. Due to the inland locations, dry ports have smaller affection on the ecological environment, but still need to contribute to protect their environment around.

*Author to whom correspondence should be addressed.

2.2. What is port ranking?

Port ranking refers to the evaluation and ranking of ports around the world or within a specific area based on a series of indicators and data to measure how important and competitive they are in the field of international trade and shipping. These indicators and data usually include cargo throughput, container throughput, ship calls, port facilities,service levels and so on. Port ranking offers stakeholders such as shipping companies, consignors of cargo and governments a reference to estimate the competitiveness and reliability of ports and make decisions correspondingly. The results of port ranking may vary because different methods and indicators might be used for assessing ports.

2.3. Who cares about port ranking?

Benefits of port ranking

2.3.1. Port operator

Ports at the top of port ranking of "Port cargo, container throughput" will attract more cargoes and containers. The higher the port ranking, the greater the operational capacity of the port is. So the port ranking helps more customers to send more cargoes to top ports.

Port ranking will encourage operators to allocate resources more rationally. The lastest port ranking of national port throughput from January to July 2023 shows that Shenzhen port dropped to rank 20 (chart 1). The main reason is that a large number of Asia-North America routes are suspended/cancelled, while Shenzhen Port focuses on US shipping line. To go higher on the ranking and increase container throughput at Shenzhen port, the port operator could transfer more manpower and material resources to support other busier routes

Port ranking makes the top ports more famous, which will attract more professional talents to work for the top ports, which could in return develop the ports better. Port operators will also try their best to improve work efficiency and quality.

2.3.2. Shipping liner

Port ranking is a comprehensive, authoritative and reliable reference list for shipping liners to select ports for shipping.

For example, through port ranking based on container port performance index, the shipping liner will find ports that save voyage time for liners, educe transportation costs, improve ship transportation capacity, and accelerate ship turnover.

What's more, small ports do not provide enough containers and cargoes. Ship companies could easily choose ports with greater cargo and container throughput as docking points to strive for supply of goods and improve space utilization.

2.3.3. Government

The port ranking is a reference for the government to do Infrastructure investments and resource allocation. The larger ports ranked in the top have greater driving capacity for the surrounding economy and higher demand for supporting facilities. The government can intuitively understand the local economic development by ports ranking and increase investments in infrastructure accordingly.

Port ranking can reflect the current situation of equipment and safety management in the port. The equipment in ports with large throughput has a large load. So, the government should supervise and strengthen the maintenance and repair of equipment in ports.

Port ranking can be a reference tool for formulating strategic planning and policies for ports. The top-ranked ports' operation, management, and construction modes are more representative and standardized. The government learned from top-ranked ports to formulate and improve the corresponding rules and systems.

3. The conceptual model

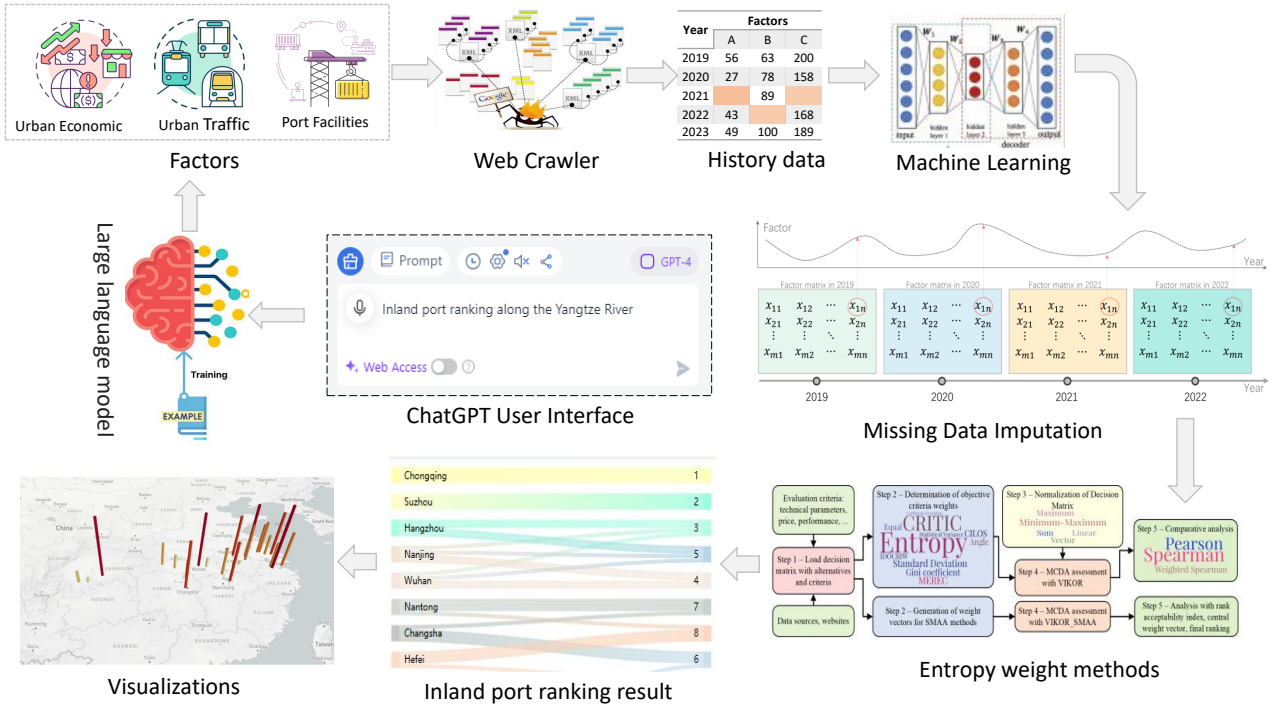

Figure 1: Caption

3.1. Factors

"Identifying important ports in maritime container shipping networks along the Maritime Silk Road" -When choosing ports to deploy the floating wind with lower cost, H. Díaz and C. Guedes Soares find ports taht near the wind farms and logistic centers is more efficiently exploit, and deep-water ports with large capacity is better.

"Inland waterway ports nodal attraction indices relevant in development strategies on regional level" O Dinu1 and others select nodal attraction measures to find that port ranking varying differently depends on network scales and ccentrality.The research on Danube inland port also verify that the closer an inland port is to a main road or highway, the better the port development will be.

"An Evaluation of Constituent Factors for Port Logistics" -Aiming at increaseing competitiveness of container ports and improving Korean port container throughput ranking, Gitae Yeo and others use the AHP(Analytic Hierarchy Process) method to evaluate weight and priority values for port logistics from'inner consisted factors' and 'outer requested factors', revealing that, for inner consisted factors, 'information system of port logistics'

First-class indicators	Second-class indicators	calculation
Port inland network scale performance index	Rail network	Length of rail connection
	Road network	distance to the nearest highway in km
	Transshipment facilities for intermodal transport	YES/NO
Port centrality performance index	Number of central places in the hinterland	
	Level of localization analysis for central places	Local
		Regional
		International
	"scale" of central places	Population
	Distance (by road or rail)	km
	waterway port to central place	Travel time/h
Port Logistics System	information system of port logistics	score
	handling system	score
hinterland condition	the size and application level of the free trade zone in the area behind the port	score
	the total container throughput transaction	USD
convenience	Port natural environment (main channel depth)	km
	the level and utilization of the port information system	score
	the stability of the port labor	average working ages
logistics cost	Inland transportation freight, ship/cargo entry and exit related charges and free installation period Terminal operating expenses	USD
Port facilities	numbers of loading and unloading equipments	
	Storage area	㎡
Port service level	Instant service, 24/7 service, instant docking loading/unloading service	score
	The professionalism and proficiency of port operators	score
	Efficiency of cargo-handling	10,000 tons/month
	Customs clearance efficiency	
	Average layover time	
	numbers of damage cargo per year	
Port operating condition	Lane coverage rate	lanes per month
	Collection and transmission system	score
	Terminal charges level	score
	Vessel availability and extent of detention	score
Port modernization management level	EDI system	score
	Safety monitoring system	score
	GPS system	score
Port finance and development image	Average throughput growth rate	%
	Earnings per share	USD
	Whole image	score

Figure 2: Enter Caption

and handling system' are as priority and the logistics cost is the most important factor among the oter requested factors.

An Analytic Hierarchy Process (AHP) Approach to Port Selection Decisions - Empirical Evidence from Nigerian Ports-About studying the factors when shippers select a port,CHINONYE UGBOMA1 conducted a survey to identify seven criteria for port selection,and used AHP to assess what port criteria are more preferred by shippers, revealing that, comprehensively, shippers attach more importance to efficiency, frequency of ship visits, and for the most preferred port LPC,location account for a quater.

"Port Competitiveness Evaluation Research based on combined model of Cluster and TOPSIS analysis"-The paper combines model of Cluster and TOPSIS analysis to evaluate port competitiveness of ten Chinese seaport, in clulding factors such as customs clearance efficiency and average layover time,Port modernization management level like EDI system,safety monitoring system and GPS system,port average throughput growth rate, earnings per share and whole image and so on.

"Structures of port connectivity, competition, and shipping networks in Europe"-This paper rank Based on the liner service networks of China-Europe and intra-Europe, the connectivity levels of 29 major European ports with respect to their China-connection centrality levels and intra-Europe centrality levels were evaluated. This shows that the largest European ports are the most "centrally" positioned for both China-Europe network (a transoceanic network) and intra-Europe network (a regional network).

"Dry port location selection using a fuzzy AHP-BWM-PROMETHEE approach"-Mohammed Mojahid Hossain Chowdhury & Ziaul Haque Munim find out that the distance between the dry port and the exporter or importer,is the crucial for establishing a dry port in Bangladesh.

"The Optimal Location of Dry Port: A Case Study of the Hinterland of Western Side of the Taiwan Straits Port Group"-Ying WANG and Jian WANG established an evaluation index with factors which will affect the development dry port, including Execution efficiency of dry port(customer satisfaction) and transport infrastructure (number of highway and railways linked to the port, Volume of regional freight transportation)

Port ranking results that vary differently depend on network scales and centrality, and that the closer a port is to a main road or highway, the better the port development will be [O Dinu1 et al.,2016; Qing Liu,2022]. Three types of centrality measures,degree centrality, betweeness centrality and closeness centrality, are indicators to comprehensively evaluating the port importance[Chengpeng Wan et al., 2021]. The factors which affect port ranking result to different extent also include logistics cost, port service, hinterland condition and convenience level [Gitae Yeo et al., 2011]. Lu Shengrong and others build a port competitiveness evaluation index system of 6 first-class indicators: port natural environment, port infrastructures, Port service-level, port operating condition, port modernization management level, and port finance, development and image. When choosing ports to deploy the floating wind with lower cost, H. Díaz and C. Guedes Soares find ports that near the wind farms and logistic centers is more efficiently exploit, and deep-water ports with large capacity is better[2023]. Adequate infrastructures, frequency of ship visits and port location draw high attention from shipper when they select a port[CHINONYE UGBOMA et al., 2006]. Dan Zhao and others introduce green performance, port finance, market share and on-time delivery rate to evaluate a port[2021].

4. LLM Full Stack Solution for Port Ranking

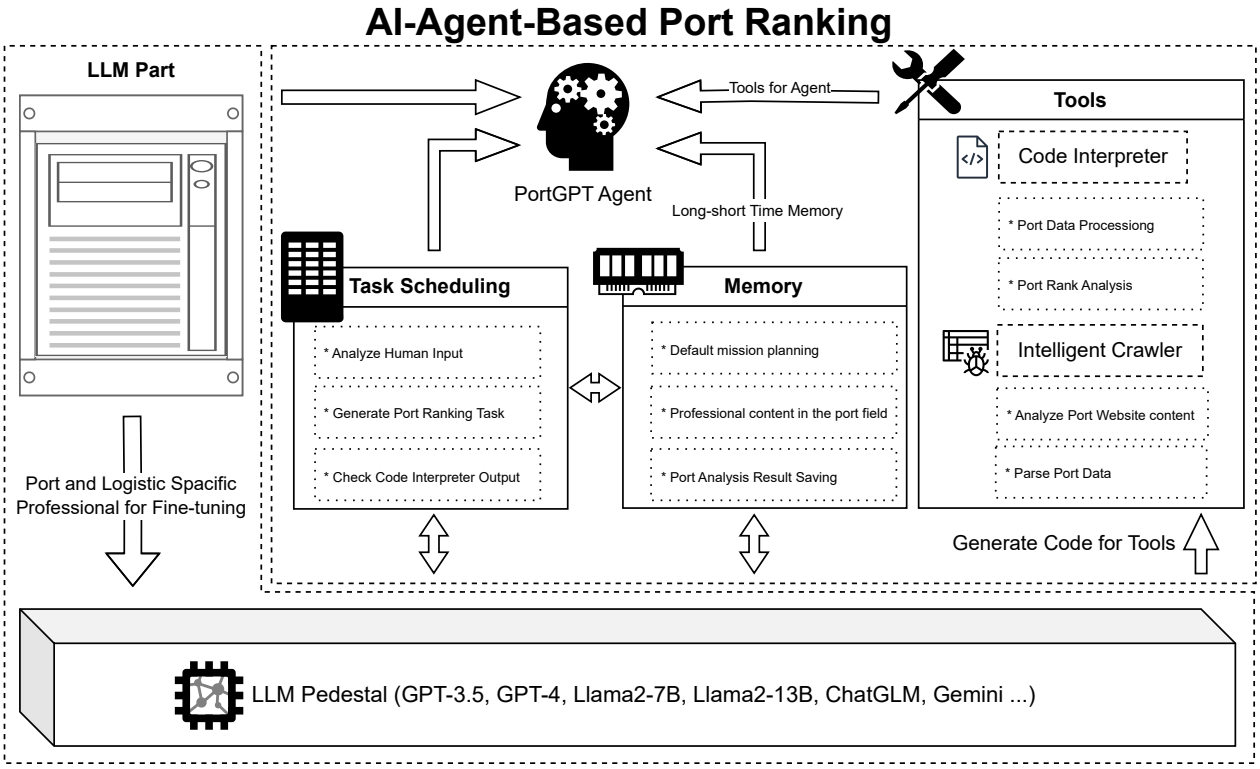

Figure 3: PortGPT Conceptual Architecture

4.1. Data collection

Data Source and Method of Collection

4.2. Missing Data imputation

[1]

References

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