

Dar Al Riyadh Insight #84

External Diseconomies of Scale

Dar Al Riyadh Insights reflect the knowledge and experience of our Board, executives and staff in leading and providing PMC, design and construction management services. Dar Al Riyadh believes in the importance of broadly sharing knowledge with our clients and staff to improve project outcomes for the benefit of the Kingdom of Saudi Arabia.

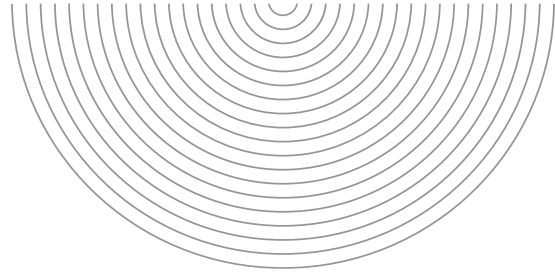
Diseconomies of Scale

Diseconomies of scale are often segregated into those arising from internal factors and those arising from externalities.

External Diseconomies of Scale

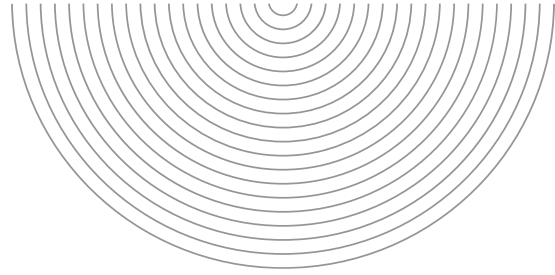
External diseconomies of scale include those arising from outside the corporate or project organization and include factors such as:

- Shortage of skilled workforce
- Shortages of materials
- Increasing transportation and logistics costs – larger scale equipment or modules may strain existing logistical infrastructure and necessitate specialized handling equipment that may not be deployed as extensively as more common site equipment. In one example, as tank sizes increased, the logistics and transportation to get the tanks to the site increased, actually limiting the tank sizes that could be used. In a second case, highway bridge capacities on viable logistics routes became the limiting factor on module size.
- Congestion (site and logistical chain) – project scaling has an impact not only on the potential size of discrete elements of supply but also on total supply volumes. Two examples are worth noting. On one large project, over 100,000 workers came to the site every day. Congestion of access roads impacted overall productivity in a number of different ways. Congestion relief required the creation of multiple pick-up locations for site staff and the creation of a dedicated, scheduled bus service to alleviate road congestion. In a second example, a site with zero lay down area and a high demand of concrete, structural steel, and other foundation and structural material required the implementation of a last-mile vehicle dispatch system and controlled staging areas so that required loads arrived in the right sequence within a 30-second window.
- Growing number of logistical links with trans-shipment – as a scale up occurs and a shift begins from materials of construction to fabricated items of supply ranging up to full modules, extended supply chains, sometimes global in nature, result. Such supply chains may include trans-shipment points at outbound ports, inbound ports, ship to rail, ship to barge, ship to road, rail to road, barge



to road, and potentially last-mile trans-shipment to self-propelled modular transporters (SPMTs). Trans-shipment points represent transitional activities with limited control by the project team and the resulting elevated points of risk.

- Scale of energy (fuel) and waste flows – construction sites are major consumers of energy, much satisfied through the use of diesel fuel. As project sites scale up, fuel shipments to the site, if by truck, consume valuable, limited logistical capacity. Prefabrication and modularization shift a portion of these logistics-consuming energy flows away from the final project site. Similarly, up to 25 percent of materials that arrive at the site leave as waste. As project scales grow, a workable solution may require more expensive step changes in solutions such as construction of a dedicated fuel pipeline or onsite waste consolidation or even processing facilities.
- Transaction cost growth with increased intermittent production – scaling of components to produce one large tank versus a series of smaller tanks, for example, can result in significantly higher transaction costs as well as production costs.
- Stretched supply chain – large scale projects often must reach further and compete harder to obtain the necessary materials of construction. This recently occurred when global supplies of steel (iron ore) and copper resulted in extended supply periods and significantly higher costs as competition for these materials in sufficient volumes accelerated.
- Limited suppliers at scale
- Increased exposure to extended construction period – this changes the quantification of risk.
- Infrastructure (industry, project related) does not keep up (infrastructure inefficiency) – road networks, power and water supply, waste and wastewater treatment, affordable housing and healthcare facilities, and staff all prove to be inadequate to meet project and project labor force needs. The project, at a minimum, may become a co-investor in needed improvements.
- Increasing complexity
- Increasing communication challenges
- Increased number of coordination and consultation points
- Increasing capital inefficiencies with scale (higher inventory levels) – routine supply chains may not have sufficient bandwidth or fidelity to operate the project in something akin to just in time supply. This necessitates the maintaining of inventories under the project's control in proximity to the project site. Inventories involve not only carrying costs but increased exposures to theft and damage. Supply chain resources and efforts greatly exceed what one would expect on a smaller scale project. At some point, a tipping point is reached as more expensive solutions (barcode; RFID) are required.
- Increased sequential and complimentary activities (coupling and correlation) – coupling and correlation grow with the number of tasks and activities. Correlation measurably increases the risks a project will face.
- Custom made designs limit the learning curve as construction proceeds – improvement results from repletion. Scaling up in projects often strives to achieve economies of scale through a series of custom solutions. At some point, more is lost than is gained.



- Project scale characteristics that appear to lower cost also lengthen the construction period – this extension is often the result of process (including approval) complexity or logistics complexity as previously described.
- Increased stakeholder engagement and longer time frames for resolution of stakeholder issues.
- Standardization typically associated with economies of scale are difficult to realize as one-off designs and fabrication and installation specialization impacts constructability.
- Longer schedules increase exposure to negative events.