Inspiration From the Shard, London

Your author explains how the iconic tower offers innovative VT design ideas for high-rise office and slender luxury residential towers.

by Hongliang Liang

The Shard; image by theotherkev-pixabay.com

Introduction

The Shard, also referred to as the Shard of Glass, Shard London Bridge and, formerly, London Bridge Tower, is a 72-story skyscraper, designed by the Italian architect Renzo Piano, in Southwark, London, that forms part of the Shard Quarter development. Standing 309.6 m, the Shard is the tallest building in the U.K., and the seventh-tallest building in Europe. It is also the second-tallest free-standing structure in the U.K.

Background

MovvéO Ltd. was responsible for the vertical-transportation (VT) design of the Shard, one of three award-winning designs the company earned from the Council on Tall Buildings and Urban Habitat (CTBUH):

- CCTV HQ, Beijing: Winner 2013 CTBUH Best Tall Building Worldwide
- The Shard, London: Winner 2013 CTBUH Best Tall Building Europe
- Burj Mohammed bin Rashid Tower, Abu Dhabi: Winner 2015 CTBUH Best Tall Building MENA

I was involved in none of these projects, as I joined MovvéO in June 2014; at the time, MovvéO Ltd. was called Lerch Bates Europe.

In 2021, I was appointed as the VT consultant for a mid-rise office project in a European country. After undertaking numerous simulations, we initially proposed a few solutions, such as dividing the building into low-rise and high-rise zones. However, all of these proposals were rejected by the client for various reasons, the main issue was called for only one dedicated goods lift, though based on its size this building would need at least two goods lifts. Given the design, if another dedicated goods lift were added, it would affect

Problem Exploration

Functions	Advantages	Disadvantages	Solutions
Second dedicated service goods/passenger lift	Convenient and comfortable	Low utilization rate, expensive in equipment and maintenance, more space taken. Domino effect for existing structure and MEP	Design one of the passenger lifts as a time-sharing goods/passenger lift.
Use one of the passenger lifts as the time-sharing goods lift	No Domino effect occurs, no impact to existing MEP, structure, etc.	Inconvenient and uncomfortable for the ofice users, as the goods/ furniture flow would disrupt passengers at the ground floor main lobby.	Put the loading bay at basement B01 instead of the ground floor, or use the rear lobby instead of front lobby at the ground floor Design the goods lift as a time-sharing goods/ passenger lift. It would be in a destination control group during peak times with the front entrance only operable at the low-rise zone. The rear entrance would be automatically put into independent mode during off-peak times Monday -Friday, weekends and public holidays. During peak time, the service lift would very unlikely be used for moving goods and office furniture. In the first couple of years, before the building occupation reaches 80%, the time-sharing lift would be used as a service lift only
One single lift car for both passenger and goods	The function would be much easier to achieve in control system and manufacturing.	The lift would serve every floor as the goods lift during off-peak times, and the car would be very easily damaged and scratched; as a result, it would degrade the office building.	With protective drapes to protect the lift car before the occupation reaches 80%. When the time-sharing lift would be used as the service lift (rather than the goods lift) during off-peak times, only authorized people are allowed to operate the lift for light, soft, clean goods; also, all of the trolleys must be well covered with soft material to prevent scratches to the car panel. Make the lift have dual cars in one sling The upper car would have entrances only at front lobbies, and the lower car would have entrances only at rear lobbies.

the proposed structure and the mechanical, electrical and plumbing (MEP), etc. After finally following TRIZ* (see sidebar) and inspired by the VT design in the Shard, I conceived the solutions:

The Principle of Time-Sharing Dual Cars Goods/Passenger Lift

1 OFF MR 1800-kg lift with "dual cars." It looks similar to a double-deck lift, but the lift would actually be a single-deck lift that would use a single-deck machine, safety gear, counterweight, etc. There are two lift cars fixed on one steel sling in one single shaft, but the loading into the two cars would never happen simultaneously. It actually is a generative design to my time-sharing service/passenger lift for the high-rise, mid-end residential tower that was published in ELEVATOR WORLD, August 2021.

The upper car would only have front entrances at the front main passenger lift lobbies, and the lower car would only have rear entrances at rear service-lift lobbies. The lift would have dual speeds: When working as a passenger lift with the upper car during peak times, the speed would be 3.5 m/s; when working as the goods lift with the lower deck, the speed would be 2.5 m/s.

For the upper car, the main lobby is at G, but for the lower car, the main lobby is at B01, where the loading bays are located.

In the first couple of years when the occupation is less than 80%, the lift would be put in goods service mode as a simplex service lift only; in this mode, only the lower car with rear entrances is operable. Once the occupation reaches 80%, the upper car of the lift would be used with the other six passenger lifts during peak times under destination group control, with only the front entrances operable. The peak times of this building would be estimated between 8:30-9:30 a.m. and during lunch time on working days. During peak times, this lift would be put into automatic group control with only its upper car and front entrances operatable.

During off-peak time, this lift would be put into goods service automatically. Only the lower car and rear entrances are operable as a simplex goods/passenger service lift, one COP with push buttons in the lower car for all served floors except the topmost floor. The car calls would be activated via a card reader, and the LOPs would be full-collection above B01 floor.

This design also could be used for high-rise luxury residential towers, where at least one dedicated goods lift would be provided for each lift core. For a luxury residential tower, the upper car should always be used for passengers, with the lower car used for goods service. This may result in the lower car being unable to serve the topmost residential floor if there is a height restriction. If so, a two-floor service platform lift would be required for goods service between the topmost floor and the topmost-1 floor. The loading bay would be ideally located at B01 floor at the rear lobby, but it would also work with the loading bay at G.

Under destination control, all of the other passenger lifts can directly serve the car-park levels in the basement. As a result, no

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dedicated car-park lifts would be required in the residential towers.

To avoid technical complexity, I think two independent controllers should be used for the two different functions. They would be used respectively for both of the cars with two sets of elevator shaft-position detecting devices. The two controllers would have a common variable-voltage/variable-frequency (VVVF) drive for different function at dual speeds.

Inspiration From the Shard

Adrian Godwin
(1958-2019)

My former boss, Adrian Godwin, used double-deck shuttle lifts for different functions in the Shard project: The hotel shuttle lifts ASL 14-ASL15 @ 6.0 m/s, upper deck for guests and lower deck for staff and guest's luggage; another pair of double-deck lifts PL19-PL20 (1600 kg) per deck @ 6 m/s, where the public uses the upper deck and the public or VIPs occasionally use the lower deck for restaurants in the public zone.

But I don't think a double-deck solution in this project would be compatible with the single deck destination control system. Even if it is compatible, the system would still have to be time-sharing, which would bring little benefit compared to a single-deck time-sharing solution. On the other hand, a double-deck lift is about 1.5-2.5 times more expensive than a single deck at the same capacity and speed, and the maintenance costs would be much greater, as well. It would definitely not be a good solution for this mid-rise office building.

Godwin was regarded as a technical genius by many experts in the industry. Even one former employee of MovvéO said he could be the best VT consultant in Europe. He had some "supertall" building innovations to improve the efficiency of the VT system:

1) "Shuttle" and "local" goods lifts
2) "Back-to-back" shafts with multifloor main lobbies
3) Time-sharing of lifts to achieve 24-h usage
4) Combining different uses of decks/entrances at varying times

It normally took me less than a half-day to reconstruct a VT diagram, but the VT diagram of Shard took me five days to complete. The review of VT design in the Shard gave me great inspiration to develop my skill/capability in VT conceptual design. Due to the "pyramid" shape, the floor areas in the high-rise zone sharply shrink, which results in the VT system being very difficult to design. The VT system in Shard is the most challenging of all of the projects I have seen. All of the above-mentioned innovations had been used in the VT design of Shard. The most impressive lift design is for the hotel/apartment service lift, which serves B03, 31 through to 67, the shaft between B03 and floor 31, which is blind (surrounded by other lifts). Without any emergency access door, the emergency rescue would have to be undertaken via another lift adjacent.

Ideas Learned From MovvéO

After MovvéO's closure, I reviewed all of my projects undertaken from June 2014 to May 2019, and reconstructed the VT diagrams in order to study the conceptual design from other experts. I also collected (from open sources) and reconstructed the VT diagrams of some of the world's tallest buildings.

There was a world-class, new VT development team in

SHUTTLES	X	ASL14–15	2*1800KG	6.0M/S	0f/B1r, [illegible] 35r/34	HOTEL/APARTMENT D/D SHUTTLE LIFTS+ Evacuation
	Y	PL19–20	2*1800KG	6.0M/S	1r/0, 4r/3, [illegible]	PUBLIC D/DECK SHUTTLE LIFTS+Evacuation
	Z	PL28–29	1600KG	5.0M/S	32, 67–68	PUBLIC SINGLE/DECK SHUTTLE LIFTS

Using all four innovations in one "supertall" (from "Lunchtime to CPD: Latest Trends in Vertical Transportation Design and BIM" by Adrian Godwin)

MovvéO; the members were Godwin, myself and my wife, Nancy Liang. I had been the design manager of MovvéO from 2014-2019, managing the whole CAD design center in the head office. I was responsible for all of the detailed VT designs in MovvéO during that time. Nancy joined MovvéO in May 2017 in a business-development role, but advanced quickly into VT traffic analysis, strategy, design and CAD drawings. Godwin alone did all of the conceptual design, but also checked our work. In the first four years, I was not allowed to directly communicate with architects. I was not allowed to touch conceptual designs, either. Instead, I created all of the drawings for Adrian to make his conceptual designs work well.

Adrian had an electrical background. He was not able to use CAD, but his conceptual VT designs had always been brilliant: His designs for lift control systems — traffic analysis application (Adsimulo*) and mobile phone app (AdInspect*) (see sidebar)
— were at the leading edge in the VT consultancy industry. Godwin created many innovative ideas in VT system design. His mechanical designs included "Skytrak" (multiple cars in one curved hoistway), a concept that won the IAEE (International Association of Elevator Engineers) inaugural prize for "High-Tech" Innovation in 2010. This and other ideas, especially the ropeless "Vertrak" with multiple cars in one vertical hoistway (similar to TK Elevator's MULTI but with a different mechanism) were very dificult (or impossible) to realize, as he underestimated the technical complexity and overestimated the market demand.

While I am a professional mechanical engineer with an MSC degree in Engineering Design and Its Management from Huddersfield University, I am also a good electrical engineer,

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the result of self-learning in China. I am confident to say that I am one of the top electrical engineers, but I can't say I am a top mechanical engineer in the U.K. lift and escalator industry. It is possible for a mechanical engineer to gain electrical knowledge at home or at work, as such knowledge is based on logical thinking in mathematics and physics, as well as the understanding of advanced theories, but not vice-versa, as mechanical design skills and knowledge would be mainly based on special training in the college/university setting and practical experiences. I don't believe self-learning from home could train a good mechanical engineer or designer.

I think Godwin's electrical background is the main reason he was a master of VT conceptual design, as he graduated with honors in electrical engineering and electronics from Salford University. Electrical design is related to handling currents in electrical circuits, while VT design is related to handling the people flow/circulations in buildings. I feel VT conceptual design is very similar to electrical circuit design, especially conceptual designs for mixed-use supertall buildings with three stacks or more being very similar with integrated circuit (IC) design. This is why those pioneers in VT traffic analysis and VT-system design normally had a first degree in electrical engineering.

Because I was not allowed to directly contact clients at MovvéO, many old customers didn't know me well. Since July 2020, I have done four projects for two different clients. I created two innovative solutions for the two clients, respectively, and am now very confident with my capability in VT conceptual design.

But there are some differences between Godwin and me, as I believe the key to engineering design is to well-deploy the function and qualities following QFD* (see sidebar), so I always use well-established technology to modify existing standard products, instead of creating a new product. I also focus on mid-range products rather than top range, because the mid-range are always in the greatest demand and have the biggest margin in the market. As consultants, we should use our experience and well-known/well-established technology to help our clients achieve success.

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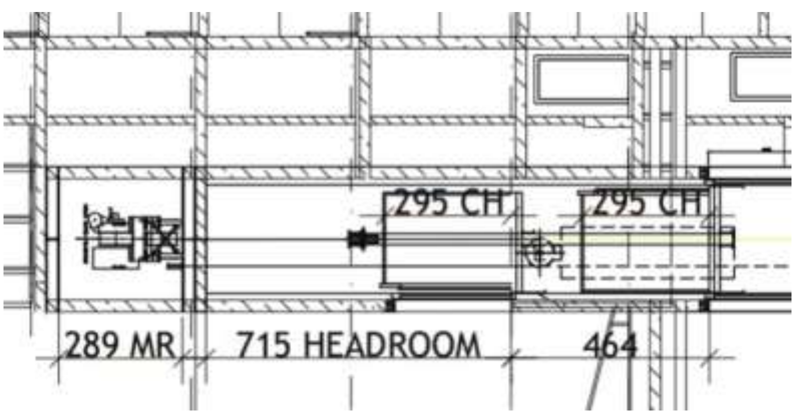
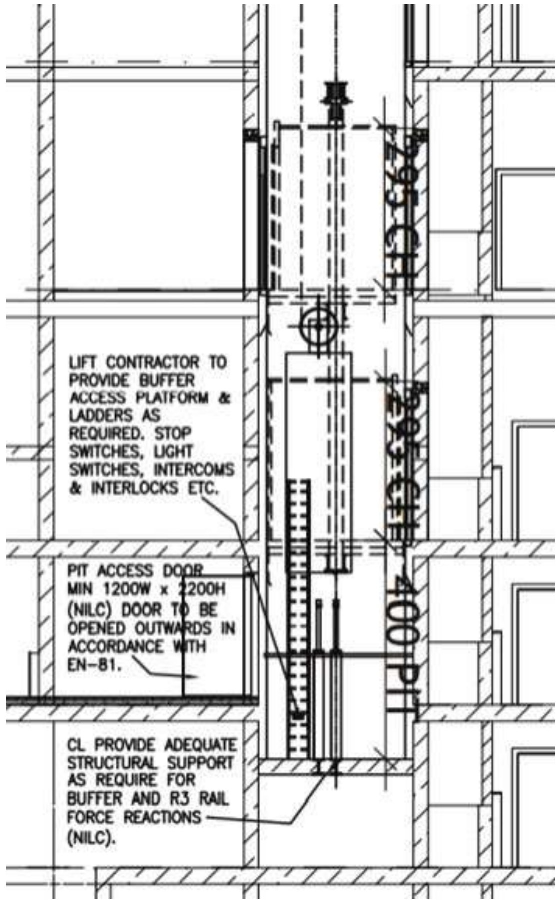
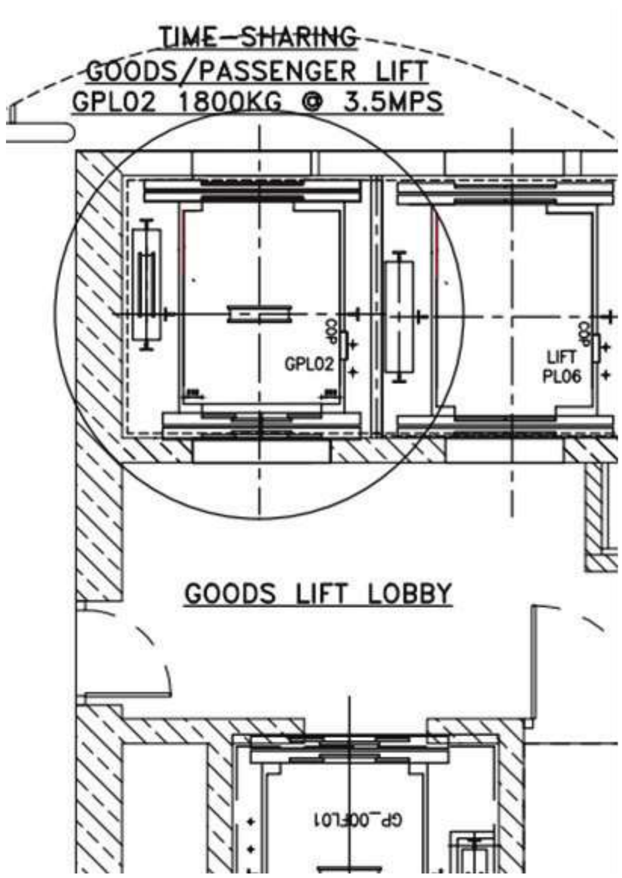
Details of the Design



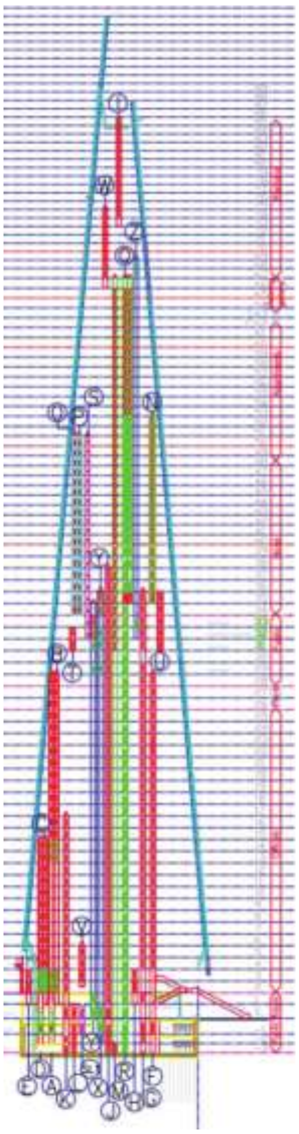
Machine room and headroom section view



Pit section view



The plan view of the time-sharing dual car passenger/goods (single deck) lift in an office building



Conclusions

This application would be based on destination control that would not be applicable with conventional control. The dual cars lift may need dual controllers but uses a common drive for both functions.

This application should not be used in mid-rise/mid-end office buildings; at least, this application must not be used as the only goods service lift in any office building. This is a perfect solution for slender luxury towers where a dedicated service lift must be provided. For this kind of residential building, the upper car should always be for passengers and the lower car should be for goods. In some special circumstances, such as the restriction of headroom height, it may be acceptable to have the upper car for goods and lower car for passengers, but special measures must be applied to prevent leakage of any liquid from upper car to spoil the lower car. Always use the upper car for firefighting and evacuation functions. In this case, the upper car should have dual entrances with the rear door facing the firefighter lobbies.

This application is not suitable for mid-rise, mid-end residential buildings. It is for high-rise luxury residential buildings with a minimum of three passenger lifts and 25 floors, especially for slender luxury buildings.

For office buildings, this dual-car lift would not be the only goods lift in the building. The upper car would still be arranged for passengers, while the lower car is for goods. The loading bay should be located at B01, rather than G. This innovation could be patentable, as is for a new product rather than a new method or program, which are unpatentable.

NYC's Central Park Residential Tower, topping off at 1,550 ft (472.4 m) with 131 floors, will be the world's tallest residential building. Standing over the iconic Central Park at 225 West 57th Street, the tower is the second-tallest building in the U.S. and the Western Hemisphere. It may also be the most expensive condo project ever, with up to US$4 billion worth of apartments sold.

The price of unit 61N is US$9.1 million. Divided by 1,435 ft^2, it equals US$6,341/ft^2, or US$68,234/m^2, making this the possible average price for this building. If one shaft for a 1000-kg passenger lift can be removed from the lift core, then the shaft

space at each floor would mean at least 5.5 m^2 could be saved, increasing the total sellable value thus: US$68,000 X 131 X 5.5 = US$48.994 million.

Author's Note

I firmly believe a good business should be open, innovative, internationalized and socially responsible — especially socially responsible, as I believe a business can survive in the future only if it is useful and able to add value to society. For my own business, I also accept the above-mentioned points as fundamental values. As a VT consultant, for my own social responsibility and to encourage competition to prevent any lift manufacturer to register the idea as the patent, I wanted to publish this article so any lift manufacturer can use this idea to bring this kind of lift to the market to protect the interest of the users. My only wish is that, if any lift manufacturer uses my idea to supply this kind dual-car lift to the market, please quote my name on the product. Ideally, the name of the product would be "Godwin-Liang Dual-Car Time-Sharing Goods/Passenger Lift."

Adrian Godwin was my mentor and my hero. I feel that I had been very lucky to have the opportunities to work under him and be involved in so many prestigious projects worldwide in MovvéO Ltd. I regard myself as the student of Adrian Godwin and the successor of MovvéO technology. Thus, this article is also dedicated to the memory of Adrian Godwin, chairman and sole owner of MovvéO, who passed away on April 30, 2019. With his passing, MovvéO Ltd. ceased operations.

Hongliang Liang, MSC CEng MCIBSE, graduated from Nanjing Architectural and Civil Engineering institute in China, majoring in hoisting transportation and construction machinery (1986-1990). He has more than 26 years' experience in the field of VT, during which time he has worked in a variety of positions, such as design, installation, quality control, lift inspection, maintenance service, product development, modernization and full replacement design in the lift and escalator industry. He joined MovvéO (formerly Lerch Bates Europe) in 2014 as senior design manager/consultant. His work was concerned with all aspects of VT design, and he was responsible for providing supporting

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design for major projects in London, Europe, Middle East and Asia. Hongliang launched his own business, Aliang Lift Design Studio, in April 2020, providing survey/design services for modernization and full-replacement projects for lift suppliers and contractors. The studio also provides VT consultancy, traffic analysis, system design, detailed design, tender negotiations for redevelopment and new-development projects to engineers, VT consultants, architects and developers.

Definitions

**Adsimulo*, a trafic-analysis application developed for architects and VT consultants. When compared with other traffic application software, it is akin to comparing digital cameras for ordinary people with manual cameras for professional photographers. As Godwin was a competitor of other VT consultants, not many VT consultants liked this app. As Godwin has passed away, I wish more VT consultants would use it. We use it, and I would like to recommend it to other VT consultants and contractors.

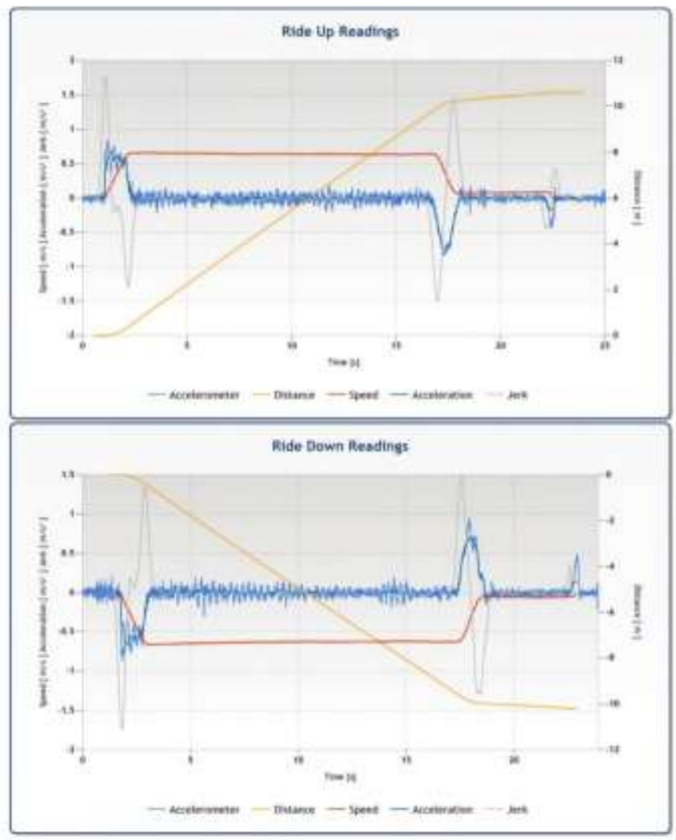
**AdInspect*, which uses the sensors for games in smartphones to measure acceleration, jerk, noise level and illumination, as well as takes photos after the inspection. By clicking on the mobile phone, a full report is automatically generated and sent to the email of the inspector in a couple of minutes.

**TRIZ*: Russian: теория решения изобретательских задач, teoriya resheniya izobretatelskikh zadatch, literal translation, "theory of the resolution of invention-related tasks" is "a problem-solving analysis and forecasting tool derived from the study of patterns of invention in the global patent literature." TRIZ was developed by the Soviet inventor and science-fiction author Genrich Altshuller (1926-1998) and his colleagues, beginning in 1946. In English, the name is typically rendered as "the theory of inventive problem-solving," and occasionally goes by the English acronym TIPS. A basic principle of TRIZ is that a technical problem is defined by contradictions. That is, if there are no contradictions, there are no problems.

**QFD*, Quality Function Deployment, is a focused methodology for carefully listening to the voice of the customer and then effectively responding to those needs and expectations. First developed in Japan in the late 1960s as a form of cause-and-effect analysis, QFD was brought to the United States in the early 1980s.

Adinspect display showing flight taking off

Adinspect display showing lift riding quality



Adinspect lift riding chart