Final Selection for Study																											
Semifinals																											
Quarter Finals																											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Continent	Australia	North America	North America	Europe	Europe	North America	Asia	Asia	Asia	North America	North America	Australia	Europe	North America	Europe	South America	North America	Asia	Asia	North America	South America	South America	Asia	Europe	Asia	Asia
Country	Australia	USA	Canada	Sweden	Germany	Massachusetts	Japan	China	China	USA	USA	Australia	Italy	USA	United Kingdon	Argentina	USA	China	Russia	USA	Brazil	Mexico	China	France	India	Turkey
City	Perth	Atlanta	Montreal	Stockholm	Munich	Boston	Tokyo	Singapore	Shanghai	San Francisco	Washington	Sydney	Naples	Chicago	London	Buenos Aires	Salt Lake City	Hong Kong	Moscow	New York	Brasília	Mexico City	Beijing	Paris	New Delhi	Ankara
System Name	TransPerth	Atlanta Metro	Monreal Metro	Stockholm Subway	Muenchen	MBTA Boston "T"	Tokyo subway	Singapore MRT	Shanghai Metro	Bay Area Rapid Transit	DC Metro	Sydney CityRail	Napoli	Chicago "L"	London Underground	Buenos Aires Metro	UTA TRAX	Hongkong Mass Transit	Moscow Metro	New York Subway	Brasília Metro	Mexico City Metro	Beijing Subway	Paris Métropolitain	New Delhi Metro	Ankara Metro
General Information – Culture	Nothing significant	arguments that lack of funding effects African Americans (78% of riders)	The metro is filled with graffati from very famous artists and the stations are architectural wonders.	Stockholm has been the cultural center of Sweden since the 13th century. Thus since WWI, the metro has been incorporated into this culture.	dependence on mass transit - punctuality	very old system in the process of modernization and transition.	famous for being exceptionally crowded	The network has since grown rapidly as a result of Singapore's aim of developing a comprehensive rail network	largest city in China which develops very fast	commuters and tourists and travelers for the airports	Being located in the Capital of the US, it is very well known as tourists from around the US and around the world use it. It exhibits late 20th century architecture and designed by Chicago architect Harry Weese.	All demographics, heavy white collar commute usage, as well as entertainment usage and lower class	dependence on mass transit, known for artwork!	mostly commuters, but also broad user base	very mixed and cosmopolitaian usage, including numerous tourists from airport traffic	Many of the stations and tunnels are filled with murals and art. Several of the stations were declared as national historical landmarks in 1997.	made for the Olympics	The Hong Kong system is based on a British design.	well utilized and national pride	The New York city subway is an integral part of the city's culture. It is famous for its graffati, crime (though that has subsided) and is featured often in TV sitcoms and films.	capital city of Brazil, but 4th largest Brazil city at 2.5 Million people. 91% service industry	Originally very high illiteracy rate, resulting in stations indicated by custom logos instead of names	Beijing's subway lines generally follow the checkerboard layout of the city.	well used by all demographics	Appeared in many Indian movies. Very popular for its cleanliness and efficiency	The Ankaray, termed a "Light Metro" system, was the first phase of the modern rapid transit network of the city.
General Information – Fame	Not much	Not overly famous - has had some famous riders	It is one of the few rubberised metro systems in the world. It is basically a system with rail cars on rubber tires operating in guideways. Thus it is very quiet and smooth. Also the Montreal metro is a pioneer in tunnel advertising.	It was the first Metro where the free newspaper concept was started, now used everywhere. Art is an integral part of the system and can be found everywhere	moderately known as a large system	Famous America's oldest subway opened in 1897 in Central Boston	very famous	first one to introduce platform sliding doors to protect passengers	fastest-growing rapid transit systems in the world	2nd busiest in US. Combined with SFMTA (cable cars :-)	It is the second busiest rapid transit in the US (after NYC).	Not well known	not famous	Famous	Most Famous	It was the first metro to be established not only in Latin America but in all of the southern hemisphere. It has also been featured in movies.	not famous	Efficient. Frequent service. High-capacity cars. Extremely affordable. Clean and modern system with air-conditioned cars.	very famous in rapid transit circles	The New York subway is the world's busiest and has the longest underground segment. It also has the world's largest single station, Grand Central Station, which covers 48 acres and two levels.	New, but minor system	Not well known	Cheap fare Fairly easy subway to navigate	very famous	Second metro transit in the country. Unlike the first one, it is a combination of under ground, ground level and elevated tracks.	currently, two types of metro lines: one light metro, one fully automatic metro
General Information – The Need for Improvement	Stated improvements include mainly extension of existing lines, improving station infrastructure and purchase of new trains.	Concerns about safety - recent high-profile crimes (3 homicides, 3 rapes in 2004-2007) - Fatality Last Thursday!	Mostly extending the lines and replacing aging cars	There is a need for improvement in punctuality and reduced cancellations	unknown	Several stations needs to be rebuilt to accommodate six-car trains and be handicap-accessible	constant need for capacity improvement	It was anticipated that daily ridership in 2020 would have grown to 4.6 million from the current 1.4 million passengers	The subway during rush hours is extremely crowded.	Numerous glitches - declining ridership and quality of service	Improvements needed include extension of service to suburnab areas such as Dulles connector and there a lot of commuters live. Also, a better information system is required to give riders updates on train status.	Seen as an underperforming system, trains often reach 135% design capacity	unknown	mainly rehab of existing track infrastructure, due to raised-configuration	periodic, ever expanding	The system is overstretched and gets overcrowded. Needs an increase in capacity.	little to no need for improvement currently	extend existing system to reach more areas	limited at this time	The main need for improvement is increase in capacity in some lines which are saturated. In fact, crowding at Lexington Ave exceeds design limits.	None apparent	No sign for expansion	The existing network cannot adequately meet the city's mass transit needs and is undergoing rapid expansion.		Very new, first line opened in 2002. No need for infrastructure improvements other than adding stations	The Metro is helping to remove some of the 933,000 private vehicles from Ankara's roads.
General Information – The Ability to Improve	Government funding exists and room for expansion exists so YES	Limited funding	Government funded and heavily depended on so yes	The system has a lot of legacy equipment which must be taken into account.	expansions planned for every line	limited funding and high debt	government support	Construction schedules for the Thomson MRT Line and Eastern Region MRT Line have been announced.	Many lines are under construction or planned to be constructed in the near future.	Funding secured for "central subway"	Extension of service to new areas is often slowed down or hindered by the differing views and various local governments. Also, funding is extremely limited. In fact, the operating agency has had to request a temporary restraining order against creditors demanding payback of loans.	Can be difficult, due to the combined system of passenger and freight services, and regional/urban lines all on the same tracks	beudget limited	public funding possible, but may be limited due to need for maintenance of existing tracks	expanding Picadilly line to the airport	Corruption, lack of funding and control by local business interests makes major improvements difficult	popular, so funding is available.	There are several extensions planned or under construction	history has shown this system to continuously grow	The ability to improve is hindered by budget cuts ($1.2 Billion deficit for 2009), reduction in staff and limits in adding new lines due to preexisting structures, flood zones etc.	Limited, as it took them so long to open initially anyway, and the system is relatively new	Demonstrated contract awards for improvement projects	The Chinese government's ¥4 trillion economic stimulus package has further accelerated the timetable for subway construction.		Government funding with full automony for the Delhi Metro Rail Corporation in managing and improving the system so YES	Three more lines are under construction
General Information – The Desire to Improve	Number of plans exist so desire is there	2 major expansions on drawing board	Yes, the Montreal metro is a proud part of the city and there is a general desire to keep improving it.	Sweden considers the Stockholm metro one of the best in Europe and there is a desire to make improvements to it.	coninituous improvements to stations, access and trians	extension and improving service		expand the system in order to connect every neighbourhood/region in Singapore	World Expo will be held in Shanghai in 2010	locked in to existing integrators	The desire to improve is strong. People living in the area served by the Washington metro want its services extended and improved.	There is a huge political and cultural push for improvement to the system, but little has been done	4 planned lines + planned integration	concentrating on the failing infrastructure more than extensions or efficiencies	East London line will be extended, and several other routes are being added to relieve congestion. They also want ATO!	Users of the system have the desire for improvement however the management, corruption and politics can get in the way	multiple planned extensions	links North West of Hong Kong to the business area of Tsim Sha Tsui.		The desire to improve is strong as the Subway is the backbone of the city's life and business.	They really just want to get it working right now. Limited system	Currently redoing cars, as of 2006 contract award	Existing plans call for 19 lines and 561 km of tracks in operation by 2015.		Yes, the plan is to cover all of New Delhi with metro service by2021	extensions
General Information – Business Case Considerations	Improvements aimed mainly at increasign ridership of commuters.	political implications based on funding and perception of mis-managed board of directors	Very old system which is heavily depended upon by the locals so funding for improvements will be available, though delayed due to local politics.	Very old system heavily depended upon by the locals. Also a wealthy city which can afford upgrades.	multiple studies/simulations already done	the MBTA faces the possibly of being merged with other state transportation agencies into a new, single transportation agency to be called MassTrans	large system, large potential, but already very automated	the rail operators are government-assisted, profit-based corporations fares are pitched at least to break-even level	profitable		Business case considerations are key in adding new stations and lines. For example the new line being planned to go to Dulles airport is primarily for commuters wanting to use the transit system to commute to work.	With the ever-growing Sydney area (spurred by the Olympics), there is substantial opportunity to improve.	not considered	potential infrastructure spending, as part of economic recovery	Long history of improvement, and ongoing signs of future developments	Lack of funding	extensions are planned, but system is currently small and simple	operated by MTR Corporation Limited (MTRC) and Kowloon Canton Railway Corporation (KCRC)		New York city is one of the main business centers in the US and is very dependent on the Subway. However general economic slowdown and budget cuts make improvements difficult.	Completion of other stations, extensions to lines, and north wing extensions	Unknown, potentially limited	Government compensates 3 billion Yuan to the company in 2008.		Improvements aimed providing a reliable metro to relieve heavy congestion on roads.	non-profit
Control System – Control Center	Supposedly one of the most advanced in Australia, built in 2005	Rail Services Control Center Located at Avondale Station	Yes, it is used to monitor delays and train flows and can issue commands to the train ATC systems.	Yes		The OCC is housed in a column-free theater-style facility with a mezzanine for an operations supervisor, emergency control, and a conference room, all with a view of the overall display board.	centralized control center, experts in field	both operating company have their own control center	each line has its own control center	centralized, similar to DC metro	A very large and extensive operations control center is located NW Washington DC.	distributed control based on line/region	central operational control post - monitros operations and security	distributed control based on line/origonal company	separate control centers for various lines. Reference 11 has information for Jubilee Line	Limited capability for keeping track of trains though Simens is helping improve the overall system	modern and centralized	There are a total of four traffic control centres in MTR, responsible for traffic and trains control on different lines		A very large control center exists in mid-town Manhattan	typical looking control center	centralized control	several control centers for different lines		Yes	none
Control System – Level of Automation	While the trains are monitored through sensors and cameras, trains are still driven by drivers. Trains do have ATP though.	Full ATC	All but one line have automatic train control, which means the operator is just there to open and close doors.	A mixture of old and new. Not all trains have ATO	Full ATC - with manual option - operators use manual mode at night for training	Full ATC just for red line and Mixture of manual operation and automatic speed regulation	fully automated operation	high	moderate	Full ATC	Washington Metro operates with a very high level of automation. One driver is on each train but is there as a backup and to operate doors.	automated signalling, but manual driving	Full ATC	older system, but mostly automated operation	Full ATC, implemented incrementally on various lines. Unspecified transitions between lines.	Mixture but mostly manual	Full ATC	high		The system is fairly automated with many lines using communications based train control.	Automated, override only, basic timetables	full automation on most lines, manual on some	the mode of control and the functions of the signal systems of existing line are generally the same	Line 14 is totally driverless	Highly automated, the system provides ATP, ATO and ATS functions such as provides automatic routing setting, monitoring of train operations, and automatic train regulation by optimization of such train operating parameters as dwell time at stations and coasting.	high
Control System – Current Methodology	Train driver operates trains manually with ATP backup	1 train operator to open doors and make announcements	Automated as described above	A combination of older signaling technologies, manually controlled and some supervision from the control center		centralized traffic control and automatic vehicle identification surveillance and control of rail traffic.	fully automated operation	The North East Line was fully automatic	CASCO provides ATS,ATP for several lines	fully automated operation	The Washington Metro uses Automatic Train Control which consists of ATO, ATP and ATS.	automated signalling, but manual driving	fully automated operation	older system, but mostly automated operation	Mixed, based on line	Mostly older signaling technologies and manually controlled	fully automated operation	Disneyland Resort Line was fully automatic.	fully automated operation	The current methodology includes a combination of manually driven trains and automated trains.	full automation with little involvement	full automation on most lines, manual on some	Automated as described above	fully automated operation	Automated as described above	fully automatic based on Alcatel's Seltrac moving block signalling.
Control System – Previous Improvement Efforts	Only the operations control center. It seems that using train drivers has remained a practice.	many improvements - original construction begain in 1975 - most recent upgrade in 2000	Steady improvements have been made over the last several decades. A brand new set of trains are expected to be acquired soon from Bombardier.	Mostly upgrading older rolling stock and adding a couple of stations		installation management of the new Operations Control by Parsons,renovation of stations and upgrade control systems		the signalling system employs state-of-the-art transmission-based moving block technology.	install supervision and the system debugging in the field		Signaling and control systems have been steadily upgraded over the last decades and now, the main effort is to reduce station over runs, especially since longer 8 car trains are being run.	System evolution vision was done by the same guy who designed and oversaw the Harbor bridge... for better or worse.		numerous intergration efforts over the years	Used @RISK (See ref 13) to improve operations	Upgrades to the signaling system and upgrading of rolling stocks	none	integrate lines to one control center		The efforts recently have been concentrated in making the whole system run as communication based train control.	None so far	always gone according to the original vision	the subway upgraded signal equipment to increase the frequency of trains and added to the capacity of subway trains.	a second parralell system was created to alleviate the problem of stations too close together	N/A new system	none
Control System – Sensors	Cameras and track sensors to monitor location of trains	unknown	There are sensors on the track that make physical contact with the train (near where the driver sits) and transmit receive information.	Sensors along the track provide information exchange between the driver and the control center	continuous transmission of control signals	provided by Switch & Signal for red line. The other lines use Cab signal system	unknown	Infra-red active sensors Microwave sensors	Smart Digital Track Circuit	location sensors on tracks + GPS	An extensive array of coils are used on tracks to sense, monitor and issue commands to trains.	regular rail contact sensors, and CCTV	SCADA system - monitors all power supply and station equipment - full monitoring of all operational and station equipment - diagonstic and optimization	unknown, but likely regular rail sensors	Conductive sensors located periodic intervals on tracks (10)	Depends on line. Some are being upgraded by Siemens and have improved signaling. Others have very little	unknown	Wireless Sensor Networks	unknown	The are numerous sensors wayside and on the trains to keep track of train location and movement.	unknown, but modern	conductive sensors, standard rail	Fiber Bragg grating (FBG) sensors	unknown	Cameras, sensors, fiber cabling and computers to keep track of train locations at all times	CCTV cameras
Control System – Integrator Involvement	EDI Rail with Bombardier to build trains, Union Switch and Signal Pty Ltd for the OCC	marco - Train control system (TCS) replacement Operations control center (OCC) assessment CAD/AVL implementation assessment Business process review (BPR)	Numerous including Bombardier, Alstom, Vickers	Numerous since the system is old. Bombardier seems to be more involved in the recent years.		Numerous since the system is old such as Parsons,Union Switch & Signal etc.		add fully automatic lines to the system	combine two control centers		Numerous integrators have been involved, most recently Jacobs Engineering.	Rail Cleanways		heavy integration efforts over the years	adRISK, as well as numerous other companies claim involvement with LU	Various local integrators but recently, Siemens		add expanded lines to the MTR network.		Numerous system integrators have been involved in the subway's long history. Currently, Parsons is helping with the control center improvements and implementing communications based train control on the remaining lines.	None, new system	very little, all government run	traction, power, station automation and emergency services.		ROTEM, Bombardier, Bharat Earth Movers Limited	heavy metro line combines with light metro line
People – Capacity	Capacity mostly meets demands except at a few stations	1600 pax per 8car train	Capacity generally meets demands	Capacity generally meets demands		increase capacity by using 6 car trains in all lines. Capacity reduced 50% by using ATC in red line camparing to wayside signal system in downtown area		40000 passengers per hour	170,000 people per hour	limited due to cars that are too large/heavy - can only run 1-2 cars/train	Currently, capacity meets demands. However it is estimated that if all trains aren't run with 8 cars by 2020, demand will exceed capacity.	capacity is expected to increase by 8% through new trains being added	different for different lines - Line 6 max 570 per train	600K per day	Numerous car types, varies	Does not at all meet demand and serious crowding occurs frequently	60000/day	60000 passengers per hour	10 million /day	The capacity exceeds demands on most lines, however there are several lines where demand exceeds capacity.	not comprehensive system, buses are more popular	very high, well used, not too crowded, so not totally saturated	800000 per hour		Capacity exceeds demand	16,000 passengers per hour
People – Daily Ridership Rate	175,000	450K/weekday 69M/Yr	835,000	1.07 million	330M/yr	1.1 million/day		1.564 million	3.065 million	173K/day	798,456	800000 rides a day	470K/day	600K per day	3.5 million/day during week	1.3 million and increasing	53K/day	3.4 million	6.8 million / day	5.02 million	140000 Passengers/day	3.9 Million passengers a day. 5th highest in the world	4.92 million	4.5 million/day	800,000	175,000
People – Demographics	Mostly commuters going to work downtown from the suburbs. Also school children use the system extensively	1.6M personnel	Extensively used by all parts of Montreal society	Extensively used by all parts of Stockholm society	1.3M inhabitants - 3rd largest city in Germany	589000		4,680,000	13.79 million		The Washington Metro is used extensively by commuters going into the city to work, tourists from around the world visiting the capital as well as others such as school children living in the city.	All demographics, heavy white collar commute usage, as well as entertainment usage and lower class	Naples - 1.2M population - second largest city in Italy	commuters mainly	mixed, seen as a tourist attraction in itself, system reaches all demographic neighborhoods	Used by various types of people including students, businesses and government workers. Property values near the metro are significantly higher than areas that are further away		6.9 million	varied	The New York subway sees people living not only in NYC but also the suburbs and New Jersey. It is used by commuters, tourists and people living in the region.	not tourists, due to layout.	Cheapest system in the world, 20 cents USD per trip. Seen as accessible for tourists as well, though	17 million		Mostly commuters going to work and shoppers/tourists going downtown	5 million
People – Culture Influences	Nothing significant	78% African-American ridership	Art and architecture very much a part of the system.	Art and architecture very much part of the system		31.60% of workers in the city proper commuted by public transportan		Singapore MRT forms the backbone of the railway system in Singapore, spanning the entire city-state.	China's largest city with more than 15 million inhabitants	widely criticized	The Washington Metro has been influenced by various cultural factors such as the poor living in the city, national level politicians, suburban commuters, etc.	frowned upon, despire relative good performance	dependency on public transportation	icon due to being mostly elevated	extreamly famous system with numerous influences worldwide. More in common with american systems than Asian	A lot of art and architecture everywhere	Was built primarily for 2002 Winter Oplympics	one of the most density populated cities in the world		The New York subway has been influenced by various factors such as immigrant populations living in concentrated areas, the different parts of the city such as the business districts, entertainment areas, poorer areas etc	the metro specifically serves the outlying areas only, and their ability to commute into the main city region	well regarded for being the cheapest in the world	increasing lines is a part of measures to take cars off the roads and improve air quality		Metro service is still fairly new to India so it is only used by more affluent riders.	The cars have no forward or rear facing seats, and no seats at the front or rear. The car's seats are made of rigid plastic.
Cases – Previous Disasters	See below	last year tornado hit downtown Atlanta - train damaged	None found	None found	None	Trolley accident	1995 Sarin attack on the system... bio terrorism	no	no	1998 - Muni Meltdown (ATC glitches)	There have been no cases of what can be called disasters	Glenbrook Rail Accident (1999) and the Waterfall Rail Accident (2003[		Comprehensive list at "http://www.chicago-l.org/mishaps/index.html"	Major bombing in 2005, numerous historical accidents	None found	none	no	blackout halted trains in 2005	The biggest disaster is the 9/11 terrorist attacks in which a station and many lines were destroyed from the collapsed WTC buildings.	none, new system	1975 with little details available (?)	On March 29, 2007, a construction site at the Suthouje station on Line 10 collapsed, burying six workers.		An accident occurred while constructing a line however no operational disasters.	no
Cases – Previous Cases (Heavy Loading)	Some overloading/delays at some stations such as	overcrowding in prevouis years - 2006 - many cars damaged from overheating, plus 50% of cars in"rehab" - shortened all trains to 4-6 cars	The green line is known to have congestion issues	None found		overloading at certain stations and certain time	very crowded, requires pushers	no	yes		Heavy loading occurs frequently during special events such as presidential inaugurations and sporting events.	Overcrowded during rush hour, 135%		crowded during rush hours	"kings cross" station has experienced closures because of overcrowding... other stations are made exit-only during certain times, and various stations have temp-closeoffs	The entire system is overstretched, and during weekdays overcrowded and with insufficient services.	none of signifigance	no	2004 terrorist bombing killed 42 in a station	The Lexington Ave line is frequently faced with demand exceeding capacity.	the system was built as part of their 2000 olympics bid	crowded during rush hours	Operators have often been forced to skip transit stops to avoid delays-induced overcrowding on one line from spilling over to other lines.		The system is under utilized	no
Cases – Accidents and minor incidents	A head-on collision between two B series trains in August 2006	2 fatal accidents + 4 derailments	A train collided with a station in 1971 which killed the driver and started a fire. Also the rubber tires have caught on fire occasionally leading to massive evacuations.	Numerous incidents recorded due to vandalism. Graffiti artists place concrete blocks on track to get warning of arriving trains. In one case, the track signal had been turned off by the artist		some accidents		few	some		Numerous accidents have occurred in the last 30 years. These include derailments, trains colliding and metro employees being hit by trains.	"underdeveloped safety culture"	known for safety	trains fell off platform in 1977	accidents occuring due to signal failures. Entire wikipedia page on individual incidents	None found though articles discuss how the outdated system has safety issues	none	few	fires and escalator accidents	There have been numerous derailments and train collisions over the history of the system.	None, new system	no major news of accidents	some		Only during construction of a line.	few
History – General History	Started off as part of the Western Australian Government Railways. Was absorbed into the TransPerth brand in 1986	first established in 60's - opened in 75, final stations opened in 2000	The system was first started in 1941 and has been continually been expanded since then.	Very old system that was first started as a tram as far back as 1910.	established 1972 - for Olympics - now one of most complex networks in Europe when coupled with S-Bahn	one of the oldest rail rapid transit systems in the US,opened in 1901	long evolution of expansion, two separate governing companies to this day	opened in 1987 establishing itself as the second-oldest metro system in Southeast Asia	opened only in 1995 as a north-south axis , by the end of 2007 the network had reached a total length of 227 km, with 161 stations and 8 lines!	1980 - first began - complicated history - interlinking back to 1918	The Washington area was planned for large highways only in the 1960s. Then a compromise of having a capital beltway plus a metro was reached. In 1966, WMATA was created by passing laws in VA, MD, DC and the federal government.	Always been a very integrated system with the rest of rail, raising complexity	First railway - 1839. modern "metro" est 1993	long history of disjoint lines, now government controled and integrated into one system	going back to 1954, very, very old system	It was first started in 1913 and was managed by the state government for a long time prior to privatization in the 1980s.	First opened in 1999	opened. In 1982, the British Section of the Kowloon-Canton Railway began its transition towards electrification		The system goes as far back as 1869. Lines were created separately as different companies but were consolidated to fall under the NY Transit Authority in 1953.	Opened in 2001. The system originally only operated between 10am and 4pm	Opened in 1969	1953-1965: origins 1965-1981: the slow beginning 1981-2000: two lines for two decades 2001-present: rapid expansion	began 1900	It was planned as far back as 1960 but construction didn't begin till 1995 and first line opening in 2002.	Opened in autumn 1997 ,construction work started 4 years earlier
History – Evolution of System	Used to be deisel, electrified fully in early 1990s		The system has slowly expanded since the 1960s, usually spurned on by major events being hosted in Montreal such as the World Fair and the Olympics.	The system first started as a tramway (hence some of the naming convention) and then was converted to a metro in the 1950s		upgrade control, stations, accessibility,service and extend lines	long evolution of expansion, two separate governing companies to this day	Since 1987, the Land Transport Authority has been expanding the system in order to connect every neighbourhood/region in Singapore.	Lines 6, 8 and 9 along with the extension to Lines 1 and 4, entered into operation at the same time		From 1976 to 1983, new lines and stations were rapidly built. Since then, new stations have continued to be added at a slower rate. currently, brand new lines are being planned.	an integrated system of regional, commuter, and local rail all in one system	has evolved from railroad to a complex system that uses 3 different kinds of rail - metro, light rail and furnicular	long history of disjoint lines, now government controled and integrated into one system	Very old, long history of evolution and improvements, has numerous closed stations	The system rapidly grew pre-world war II but over the last few decades, upgrade and upkeep has steadily dropped	brand new, no evolution yet	MTR Corporation Limited and Kowloon-Canton Railway Corporation, merged on 2 December 2007, to form a single rapid transit network.	linear growth in track and stations since inception of system	The system has steadily evolved from steam engine to electric to fully automated in sections today.	None, new system	7 stages of development	1.Increasing Capacity 2.Cellular Network Coverage 3.Access for the Physically Disabled. 4.Automatic Fare Collection System		Brand new so designed and built as a modern transit system	system is new
Track – Flexibility	limited due to simple topology	all tracks meet at 1 central station.. All tracks have parallel - ability to single track when required	Flexible as long as the rubberized guideway technology impacts are taken into consideration	Not so flexible since legacy equipment must be supported	flexible, but trains cannot be turned around on the track - there are N and S sections	There are no direct track connections between lines, except between the Red Line and Ashmont-Mattapan High Speed Line	very flexible, due to very comlex network toplogy	high	high	interconnects with regional transit - above and below ground	The system is fairly flexible with multiple locations to turn trains around and to move trains between tracks.	Very High, due to nesting and looping structures in lines	not flexible between lines at all	limited, due to hub and spoke	Lacks express tracks for skipping maintenance and station areas	Not very flexible due to track topology.	limited due to simple routes	high		The system is fairly flexible as trains can be run on different tracks, however various levels of automation and track sensors exist so that must be taken into account.	Limited, only two lines	moderate, but not much overlap in lines	high		Flexible since it is new. However very strict conservation and environmental rules due to the desire to reduce pollution in the city	high
Track – Complexity	Simple	generally straight forward - but combines with bus system	Moderate	High since it is a large system with new and old trains.	complex	simple but combine with light rail	extreamly complex	low	moderate	simple when isolated to metro	The system is large but not too complex.	High	complex	simple, but fairly large system	Highly nested, multiple paths possible	Simple layout however old trains make operations complex	Simple	high	very high	The system is very complex with features such as express lines.	Low	Moderate, due to line-separation	moderate	The system is very complex	Moderate as compared to larger systems	low
Track – Size	107 miles total	46 route miles	40.6 miles	65.7 miles	93KM	101.5 km	126 miles	113.2 km	225 km	71.5M	106 miles currently but to be extended soon	Very Large	53.8KM	106 miles	250 miles	32.5 miles	31.3 KM	211.6 km	181 miles	842 miles	Great distances between stations, 26 miles total	Very Large	561 km	133 miles	46 miles	23.4 km
Track – Separate Lines	Five narrow guage lines	4 lines - with overlaps	Four Lines (guideways)	Seven	6	4	9	11	8	7	5	Numerous	7 + 3 planned (4 furnicular)	8	11	Six	2	10	12	26	2, but all joined in a "Y" configuration. Very simple layout.	11	8	16	Three broad guage lines	2
Track – Station Size	Small to medium	large and bright, 183 m long platforms to accomodate 8 car trains	Varying sizes (many large) but mostly under ground due to winter weather. Thus integrated with underground world	Medium and large		most stations are upgraded to accommodate 6 car trains	large	moderate	moderate	underutilized due to oversized cars	The transfer points downtown are very large underground stations with multiple levels. The outlet stations especially near the suburbs are smaller and above ground.	Variable		Variable	Variable	Medium and large	moderate	moderate	large	The system has medium to very large stations including the world's largest, Grand Central Station, which is 2 levels and 48 acres.	No complex statiosn	Variable	moderate	variable	Mostly medium sized	moderate
Track – Number of Stations	69	36	68	100	98	43	168	66	162	33	86	302	69	144	270	74	28	150	177	468	24	185	123	300	67	22
Track – General Topology	Like an asterix, the lines begin in the suburbs and intersect in the center of the city	Cross - similar to WMATA	Two lines are parallel while one creates a large U that surrounds the parallel lines. The fourth is a shorter line	Star shaped with all the lines intersecting in the center of the city. Also, each line has branches that come off of the mail line further outside of the city.	interconnected with S-Bahn	flines cross in downtown area forming a "T"	mixed with existing system, extream complexity	orbital	complex network	above and below ground - backbone is 2 interconnected tunnels	The topology is generally like an asterix with the lines meeting downtown. However the red line creates a large U.	Extreamly complex	zone	hub and spoke	Very complex	Shaped like a fork, so those who want to switch lines need to travel all the way east to the intersection points to change trains.	T	extension	star and ring	The topology is based on the geography of the city and the proximity to the water. The lines come south and head east, making approximately a "G" shape.	"Y" configuration	Grid-like	symmetric	mostly star	East-West and North-South lines intersecting in the middle like the Washington Metro	straight
Trains – Configuration Flexibility	All lines are the same guage so all trains can be used on all lines	electrofied steel wheel trains 2-8 car trains	All lines are guideways so	The system has both old trains and new trains with different levels of automation so this must be taken into account while assigning trains to tracks.	3 different configurations	The system has both old trains and new trains with different levels of automation so this must be taken into account while assigning trains to tracks.	very flexible, due to very comlex network toplogy	moderate	moderate		The trains are mostly flexible in configuration, however some of the older red line trains may not be suitable for other lines.	common stock on all system, but can include deisel on further out routes (not considered)	difficult when include furnicular	configurable in pairs	different types, all the same guage, but some are restricted by tunnel height	Limited due to the topology of the lines	all trains the same	moderate		Configuration flexibility is limited by complex features such as high speed lines.	Metro service is provided by 20 4-car trains with a capacity to carry 1350 passengers. [2]	very flexible due to grid layout	moderate	different trains required for various track types	All lines are the same guage so all trains can be used on all lines	high
Trains – Utilization Rate	Varying depending on time of year and location		Varying depending on time of year and location	Varying depending on time of year and location		ridership increases along with extra capacity by using 6 car trains		moderate	high		This is a particular issue for the system. The trains are overutilized on certain lines in certain directions depending on time of the day (morning rush hour/evening rush hour) and under utilized in the reverse direction.	Exceeding capacity on numerous lines, 135% utilization		About 1200 cars total	Saturated	Over utilized	unknown	moderate		Some lines like the Lexington Line are over utilized while others are underutilized. It is heavily dependent on time of day (morning rush or evening rush). Also congestion based pricing on the roads impacts the subway utilization.	20 trains total, close to capacity	heavy	high	4.5 million/day	Lower than available capacity	moderate
Management – Laws	Covered by Western Australia government laws	maintains own police force - 200+ sworn officers	Local laws apply	Stockholm City Council so it's lews largley apply		state, federal laws independent law enforcement agency,Massachusetts Bay Transportation Authority Police	first and last car are for women only!	Government of Singapore	given by Chinese government	1-2 cars	State and local laws apply on the metro.	largely uninforced passengers laws		government and local authorities	Alcohol wasn't banned until 2008, resulting in the "Last Round on the Underground" party... interesting.	State and federal laws apply but a lot of local business influence		government of Hong Kong		Along with City, State and Federal laws, Ny Transit Authority has its own Code of Conduct for passengers and employees.	government and local authorities	government and local authorities	given by Chinese government		New law passed specifically for operation of the metro	government of Turkey
Management – Oversight Agency	Public Transport Authority of Western Australia	MARTA/board of directors	Société de transport de Montréal	Stockholm City Council	MVG	Commonwealth of Massachusetts	Tokyo Metropolitan Bureau of Transportation.	government of Singapore	Department of Transportation	SFMTA	Washington Metropolitan Area Transit Authority (WMATA)	RailCorp	metronapoli - a state-controlled joint stock corporation	Chicago Transit Authority	Transport for London	Metrovias (a lot of local business inclusence) for daily operations, state run Subterráneos de Buenos Aires owns tracks and performs long term improvements	Utah Transit Authority	government of Hong Kong		New York Transit Authority	Companhia do Metropolitano do Distrito Federal	Mexican Federal District	Department of Transportation	Régie Autonome des Transports Parisiens (RATP/Autonomous Operator of Parisian Transports)	Delhi Metro Rail Corporation	government of Turkey
Management – Policies	provide affordable transit		To provide high quality rail service to all municipalities served by the system.	To improve overall service of the system.		increasing public transit to compensate for increased automobile pollution the T was granted a dedicated revenue stream consisting of amounts assessed on served cities and towns	english and japanese language for communications	SMRT Corporation and SBS Transit	Shanghai Modern Rail Transit Co. Ltd. (SMRT) and Shanghai Metro Operation Co. Ltd		Increase ridership, reduce dependence on automobiles, encourage vitalization and growth in the areas served by the system	provide regional transit seamless with the downtown underground system		provide affordable transit and reduce congestion	Makes available a "Journey Planner" for planning trips according to timetables across multiple systems	Very disjoint with multiple conflicting interests		MTR Corporation Limited	no timetable due to the frequency of trains	To operate the NYC transit systems in a safe and efficient manner.	provide affordable transit and reduce congestion	run by the Mexcian Federal District	Beijing Mass Transit Railway Operation Corp. Ltd		To cover New Delhi with metro rail by 2021	Ankara Metro Consortium
Funding – Subsidy	Yes	Bonds and 1% county sales tax	Yes	Yes	state	all costs above revenue collected by Commonwealth of Massachusetts... 1% of the 5% state sales tax	federally funded	no	no	mostly federal	Yes, from the DC, VA and MD local governments (primarily through gasoline taxes, etc).	2 billion AUD a year, 5% of the state budget.	state	increasing subsidies over time	independent, not much reliance on subsidies	Yes	Federal Transit Administration/property tax/sales tax	no		Yes	fully government owned	fully government owned	from government		Yes	yes
Funding – History	Funded by the Western Australian government from the beginning	general concern over lack of state and regional funding	It has always been funded by the municipalities it serves (through taxes)	From the 1920s, public transport systems have been take over by the city and funded through taxes.		1% of the 5% state sales tax, passenger fares, and formula assessments of the cities and towns in its service area		construction funding from government	government of China		Funding for the Washington Metro has always been through the DC, VA, MD local governments along with some federal funding.	State-owned corporation, RailCorp		historically separated lines, unified in 1924	Historically government funded	The system has been pivatized, nationalized and privatized again. Government heavily involved in funding.		Hong Kong government		Generally, the capital costs are paid by the city and state but the operating costs are mostly covered by the fares (67% of the budget)	System was free to use for first 7 years.	7 stage development	government of China		Funded by the Government of India as New Delhi is union territory	Turkey government
Accessibility of Information	Limited	very good	Moderate	Moderate	decent - multiple studies	pretty available - but some were out of date since it has been renovating		moderate	low	limited due to Booz Allen Hamilton proprietary info	Good	Good	pretty available - but language may be issue	Good	Excellent	Limited		moderate		Good	Limited, as not a famous system	Fair	low		Moderate	low
Accessibility of Contacts	Limited	Moderate	Language barrier unless one of us can speak French	Language barrier		should be fine		moderate	low		Good	Limited	Have access to personnel in Naples	Good	Moderate	Limited, language barrier unless we know Spanish		high		Good	Very Limited, Portugese	Limited	low		Limited	low
Control – ATP	Yes	automatic speed control with collision protection at 34 interlockings - manual intervention	Yes	Yes	Yes	fully automatic in red line controled by OCC	Yes	Centralized computer control with centralized manual control fully automatic in NE line	Centralized computer control with centralized manual control	ATC	Yes	Not Implemented as of yet! Has resulted in the two accidents		Full ATC with built in saftey and overrides	Reference 10 has good description of technical implementation. Fairly standard.	Limited to none		Centralized computer control with centralized manual control fully automatic in APM		On some	Full ATC with built in saftey and overrides	Full ATC with built in saftey and overrides	Centralized computer control with centralized manual control	on some lines	Yes	fully automatic based on Alcatel's Seltrac moving block signalling.
Control – ATO	No	On-board controller to open doors and make announcements	Yes	Only on the green line	Yes	fully automatic in red line controled by OCC manual in other lines except for silverbird cars which