The RTA's Transit Asset Condition Assessment Study

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ABSTRACT: Traditionally, transit systems managed their assets on an as-needed basis, but the urgency of overcoming deferred maintenance in the 1980s brought about an interest in capital programming to better systematize the modernization of the physical plant. Since the early 21st century, efforts to plan for capital maintenance needs have taken the form of the more ongoing process of asset management. Responding to several critical needs in Chicago area transit infrastructure since the late 1980s, the Regional Transportation Authority (RTA) commissioned an asset condition assessment for transit in northeastern Illinois. The resulting study, released in 2010, is an industry leader in taking stock of an entire region's transit capital assets. It establishes an estimated replacement cost for the system, and ten-year state-of-good-repair needs. RTA intends to make an annual revision of this assessment into an ongoing process, and is using the data as part of its overall performance measurement process. A decision tool is being developed in cooperation with other transit systems to help prioritize investments based on the condition, importance and impact of different assets.

The early 21st agency finds transit agencies struggling to accomplish more with fewer resources. As a new generation of transportation officials faces up to the need to rehabilitate or replace their aging rolling stock and deteriorating physical plants, it becomes all the more important to invest limited capital funds where they will do the most good. In order to best prioritize needs, the Regional Transportation Authority of Northeastern Illinois (RTA) is systematically taking stock of the physical assets of the transit operators serving the Chicago metropolitan area.

This paper first considers the historical background of today's asset condition assessment efforts, which are a modern outgrowth of efforts to reverse the longstanding physical neglect of major transit systems—an unfortunate, painful and expensive process which came to a head in the 1970s and led to extensive rehabilitation work starting in the 1980s.

Next, the Chicago institutional setting is briefly described, followed by an exploration of situations that have arisen since the 1970s where deteriorated rail lines were rebuilt. The RTA's asset condition assessment study is then described, followed by involvement of the Federal Transit Administration and future directions for the study.

CHALLENGE OF DETERIORATING ASSETS

Up through the 1970s, transit authorities had largely been upgrading their physical plants in response to pressing needs. Equipment or facilities at the end of their useful service lives were replaced if the agency had the requisite combination of resources and political support. Otherwise, the assets were allowed to decay, sometimes almost to the point of becoming unusable.

By the late 1970s the limitations of this *ad hoc* approach to the long-run upkeep of buses, rail cars and fixed facilities became painfully evident on such systems as Ohio's Greater Cleveland Regional Transit Authority, Philadelphia's Southeastern Pennsylvania Transportation Authority (SEPTA), and most notably the New York

City Transit Authority.[1] Although maintenance standards varied among properties, by the end of the 1970s practically every system with tracks, structures and stations dating from the years between the 1890s and the 1930s was experiencing capital maintenance issues. This description of Philadelphia's commuter rail system could equally apply to several other rail systems in older industrial cities, where

> much of the physical plant was permitted to decay. Ridership was dropping fast after the boom years of World War II, and expenses were rising even faster. … Routine maintenance of stations all but ceased. Even such things as broken steps and burned-out light bulbs were often ignored. …
>
> Decreased service and frequent delays and breakdowns resulted in more and more riders seeking alternative means of getting to work, usually turning to their automobiles.[2]

Eventually matters came to a head as transit authorities faced critical decisions about rehabilitating key rail lines. New York City Transit Authority (now New York City Transit), SEPTA, Chicago Transit Authority (CTA) and other properties found themselves spending huge sums to thoroughly rebuild and rehabilitate tracks, structures, stations and other assets, in large measure because they had been allowed to fall well below a state of good repair. On Chicago's Green Line (rebuilt in 1994-96),

> A century of frequent and continuous service, much of it by trains composed of heavyweight cars, did not permit the steel spans to age gracefully. … In addition, the track had far exceeded its useful life …
>
> The combined impact of these deficiencies caused drastic reductions in speed limits across large segments of the line. Running time suffered accordingly. For example, the running time … between Oak Park and the [downtown] Loop, was 20 minutes in 1983. By 1994, the running time had increased to over 30 minutes.[3]

Fortunately, most disruptions resulting from deferred maintenance have been confined to scheduled downtime for reconstruction work, but occasionally events have intervened unexpectedly. In 1977, cracks on a rapid transit bridge temporarily forced suspension of service on both the CTA's busy Dan Ryan rapid transit line and the Rock Island commuter rail line running beneath the bridge.[4] In another instance, a week after the 1984 opening of Philadelphia's long-awaited Center City commuter rail tunnel, SEPTA was forced to suspend service on half of the combined operation when structural flaws were found on one part of the former Reading Company's viaduct through North Philadelphia. Repairs were made and service was restored after 17 days, but the issues were not limited to that particular segment of the viaduct. SEPTA conducted a detailed engineering study and completely rebuilt the viaduct, requiring prolonged track outages during the summers of 1992 and 1993.[5]

The accumulation of deferred maintenance does not affect the ability of transit riders to complete trips successfully. It can, however, significantly affect travel times. Furthermore, it can also affect the reliability of travel, as unexpected delays (particularly those due to mechanical failures of vehicles or infrastructure systems) force riders to add greater time margins when planning travel than would be the case for a transit property performing more comprehensive maintenance on its rolling stock and fixed plant.

CAPITAL PROGRAMMING: PRECURSOR OF ASSET MANAGEMENT

By the early 1980s, the earlier approach of reinvesting in the system only when the need became conspicuously apparent had become discredited. The sheer magnitude of investment needed in New York's far-flung but neglected system showed that individual system elements could no longer be considered in isolation from one another.

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[1] Landgraf, Robert J., "Cleveland's Light Rail System in the 1980s: The Ongoing Revolution," in *Transportation Research Record 1361*, Washington, 1992, p. 259; Tom Kizzia, "Philadelphia: Help is on the way – and none too soon," *Railway Age*, July 14, 1980; Bill Fahrenwald, "Winning a catch-up game," *Railway Age*, June 1984; Ron DeGraw, "As Fast as a Speeding Bullet: Rebuilding the Norristown High-Speed Line," in *Transportation Research Record 1361*, Washington: Transportation Research Board, 1992; David L Gunn., "New York's transit rebound," *Progressive Railroading*, August 1989; and Keith J. Hom, "Reinventing Transit: The Twenty-year Overnight Success Story of NYC Transit," presented at the Metropolitan Conference on Public Transportation Research, Chicago, June 11, 1999.

[2] DeGraw, Ron, "Regional Rail: The Philadelphia Story," in *Transportation Research Record 1433*, Washington: Transportation Research Board, 1994, p. 107.

[3] Abrams, Steven H., "CTA's Recent Experience with Major Rail Rehabilitation Projects," in *Transportation Research Record 1623*, Washington: Transportation Research Board, 1998, pp. 108-109.

[4] Young, David, "Disaster," *Mass Transit*, April 1978.

[5] Vantuono, William C., "Meeting the RailWorks Challenge," *Railway Age*, March 1993.

As transit agencies sought to address their sometimes-daunting maintenance and replacement needs, they developed a more systematic approach which became known as capital programming. A major part of capital programming involved using information technology to inventory a property's assets and monitor the progress of rehabilitation and replacement projects. The New York City Transit Authority and its parent agency, the Metropolitan Transportation Authority (MTA), were leaders in this process.

Capital programming combined elements of strategic planning and project management, but the most important advance it offered was to apply a systems approach to all the capital assets of a transit system. One capital programming effort involving seven medium- to larger-sized properties was described in these terms:

> [T]he San Francisco area Metropolitan Transportation Commission [MTC] … initiated a project … to set regional priorities for capital investment. Borrowing a concept from private sector strategic planning, the MTC undertook … to provide the region with a preliminary estimate of its *capital readiness* to maintain and enhance the public transportation system … over the long term.[6]

In 1988, the Transportation Research Board devoted *Transportation Research Record 1165* entirely to capital programming and strategic planning. In that volume, papers discussed applications of capital programming at Chicago's RTA, Port Authority Trans-Hudson (PATH), San Diego's Metropolitan Transportation Development Board (the functions of which have since been reallocated to other agencies), Seattle's King County Metro, and the Washington Metropolitan Area Transit Authority (WMATA).

RISE OF TRANSIT ASSET MANAGEMENT

With transit agencies putting their physical assets in a significantly better state of repair by the early 1990s, capital programming seems to have receded somewhat from the industry's consciousness. But a new set of urgent needs for rehabilitating aging infrastructure have since emerged, including Philadelphia's Frankford and Market St. rapid transit lines[7] and several Chicago rail lines.

A new generation of transit officials became interested in asset management, as industry leaders became accustomed to the fact that keeping a large and complex transit property in a state of good repair requires ongoing vigilance and work. As recently as the 1990s, the prevailing view was that

> asset management was something private-sector companies did … In September 1996, AASHTO and the FHWA held the first asset management workshop focused on sharing experiences in the public and private sectors. …
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> The first [AASHTO-FHWA] workshop on asset management defined [it] as "a systematic process of maintaining, upgrading, and operating physical assets cost-effectively. It combines sound business practices and economic theory, and it provides tools to facilitate a more organized logical approach to decision making. …"[8]

Asset management is closely related to capital programming of the 1980s in its concern with catching up with and keeping ahead of maintenance needs, but it is more immediately concerned with monitoring the physical condition of buses, trains, stations, platforms, tracks, rights-of-way, garages, shops, yards and transit terminals. There is also a greater interest in private sector criteria for assessment and decision-making. Since the 2000 publication of *Transportation Research Record 1729*, which included several articles on transportation asset management, a substantial body of literature has emerged on asset management for transportation.[9]

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[6] *Transit Capital Planning in the San Francisco Bay Area*, Washington: Urban Mass Transportation Administration, December 1982.

[7] Palmer, James W., "Track Time: Construction or the Customer," in *Transportation Research Record 1623*, Washington: Transportation Research Board, 1998; also Julian Wolinsky, "Detailed planning and careful coordination pays off, *Metro Report International*, December 2010.

[8] McNeil, Sue, Mary Lynn Tishcer, and Allen J. DeBlasio, "Asset Management: What Is the Fuss?" in *Transportation Research Record 1729*, Washington: Transportation Research Board, 2000.

[9] See Hamilton, William E., "Transportation: Asset Management," *Fiscal Forum* (Michigan House Fiscal Agency), February 2001; Yehuda Kleiner, "Scheduling Inspection and Renewal of Large Infrastructure Assets," *Journal of Infrastructure Systems*, December 2001; Kristen Hutchins, "Managing Your Money: Asset Management Solutions," *Mass Transit*, December 2005—January 2006; Patricia Hendren, *Asset Management in Planning and Operations*, Transportation Research Circular E-C076: Washington: Transportation Research Board, June 2005; Kathryn A. Zimmerman and Leslie A. Sweet, *6th National Conference on Transportation Asset Management*, Transportation Research Ciecular E-C093, March 2006; Ted Farragut and Sue McNeil, *Transportation Asset Management: Strategic Workshop for Department of Transportation Executives*, Transportation Research

Transit systems have been part of this new emphasis on asset management.[10] New York's MTA and the San Francisco Municipal Transportation Agency have assessed their long-term capital needs.[11] During the early years of the 21st century, the Chicago Transit Authority was in the forefront of using information technology to document the condition of its rail and bus assets.[12]

TRANSIT ASSET MANAGEMENT IN CHICAGO

The Regional Transportation Authority is the region's lead agency for asset management at one of the largest transit networks in the US. RTA is the funding, oversight, and long-range planning agency for three transit operators, known in northeastern Illinois as service boards:

- Chicago Transit Authority operates bus and rapid transit in the City of Chicago and several suburbs in adjacent parts of Cook County (of which Chicago is the county seat).
- Metra operates commuter rail throughout the six-county northeastern Illinois region.
- Pace operates fixed-route bus service throughout the suburban parts of the region (also serving rapid transit stations and other connection points with CTA in and adjacent to the City of Chicago). Pace is also the paratransit agency for all parts of the region, city and suburbs.

Background for Asset Management at Chicago's Transit Agencies

There is ample justification for assessing the condition of the transit system in northeastern Illinois. Transit agencies in the Chicago area have reinvested heavily in the physical future of rail lines, and have made choices among alternative construction plans with varying impacts on cost levels, the duration of construction, and service (and thus on ridership).

- By the late 1970s, the commuter rail operation of the bankrupt Chicago, Rock Island & Pacific was in a very poor state of repair, with substantial impacts on running times and reliability. Even though slow orders were widespread, low-speed derailments were common enough to be unremarkable. Starting in 1978, RTA oversaw a complete physical overhaul of the Rock Island's commuter territory,[13] now owned, operated and maintained by Metra.[14]
- CTA closed the Skokie Swift (today's Yellow Line) between Howard and Skokie/Dempster for thorough rebuilding of the track and roadbed between July and November 1991. Although the Yellow Line was built to very high standards when it opened in 1925, normal wear and tear over the intervening decades (resulting in slow orders that affected operations) made the complete physical renewal of the line necessary. CTA chose an extended closure with nonstop substitute bus service as less problematic than attempting to operate trains reliably with single-tracking, particularly during rush hours.[15]
- By the early 1990s, CTA's Green Line, comprised of the Lake Street 'L' (as elevated lines are known in Chicago) on the West Side and the South Side 'L,' had deteriorated to the point where the Green Line, which was greatly affected by slow orders, was barely suitable for operation. CTA was weighing investment options on all three of its West Side rail lines[16] when a decision

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Circular E-C131, Washington: Transportation Research Board, November 2008; *Applying Transportation Asset Management in Connecticut*, Hartford: Connecticut Academy of Science and Engineering, Dec. 15, 2008; and *Model Framework for Assessment of State, Performance, and Management of Canada's Core Public Infrastructure*, Ottawa: National Research Council of Canada and National Roundtable on Sustainable Infrastructure, May 2009.

[10] Tomeh, Osama, Stephen Brady, and Douglas Skoruposki, "National Bus and Facilities Condition Assessment," in *Transportation Research Record 1760*, Washington: Transportation Research Board, 2001.

[11] *Twenty Year Capital Needs Assessment: 2010-2029*, Draft Report, New York: Metropolitan Transportation Authority, August 2009; also "Capital Asset Inventory & State of Good Repair," presentation to Board of Directors, San Francisco Municipal Transportation Authority, August 3, 2010.

[12] Shiffer, Michael *et al.*, "Spatial Multimedia Representation of Chicago Transit Authority Rail Infrastructure," in *Transportation Research Record 1838*, Washington: Transportation Research Board, 2003; also D. Zhai *et al.*, "Managing the Chicago Transit Authority's Infrastructure Using Spatially Referenced Asset Management," in *Applications of Advanced Technologies in Transportation Engineering*, Reston, VA: American Society of Civil Engineers, 2004.

[13] Young, David, "The Rock Island: Back From the Brink," *Mass Transit*, November 1978; also Bill Fahrenwald, "Chicago: A comeback story?" *Railway Age*, February 1983.

[14] The 1983 changes to the RTA Act created Metra and Pace as separate agencies.

[15] Abrams, Steven H., "CTA's Recent Experience with Major Rail Rehabilitation Projects," in *Transportation Research Record 1623*, Washington: Transportation Research Board, 1998, p. 108.

[16] Eash, Ron, Kenneth Dallmeyer, and Richard Cook, "Ridership Forecasting for Chicago Transit Authority's West Corridor Project," in *Transportation Research Record*

was made to rebuild the original elevated structures. The Green Line was closed altogether for reconstruction in January 1994, reopening in May 1996.[17] CTA provided substitute express bus service during the closure.[18] By giving contractors exclusive occupancy for slightly over two years, the total duration of construction was minimized. However, some riders who made satisfactory alternative arrangements while service was suspended did not return to the Green Line when it reopened.

- A decade later, the Douglas Park 'L', then known as the 54/Cermak branch of the Blue Line and today operated as CTA's Pink Line, had deteriorated to the point where it was necessary to replace the original elevated structures and stations with aerial guideways and new stations. To avoid prolonged closures, construction crews took possession of the line only on weekends. Although this resulted in a longer and more expensive construction period (from 2001 through 2005), CTA did not face the same challenge of rebuilding ridership as it did with the reopened Yellow and Green lines.
- CTA performed extensive reconstruction work on the Dan Ryan portion of the Red Line—the busiest rail line on the South Side—between 2004 and 2007. Opened in 1969, the line had sustained much wear and tear on its tracks and roadbed after three and a half decades of operation in the median strip of a busy expressway. To ensure continuous service, much temporary trackage had to be built (resulting in operation at reduced speeds).
- In 1991 and again in 2007-08, CTA performed extensive trackwork in the State St. Subway portion of the Red Line. The tight confines of the subway prevented this work from being done while trains were operating. CTA provided exclusive occupancy windows for construction on weeknights and weekends by routing Red Line trains onto the elevated alignment used by the Brown Line.
- Between 2007 and 2009, CTA carried out its Brown Line capacity enhancement project, which involved rebuilding stations so that they could accommodate trains of up to eight cars (rather than six) and complied with the Americans with Disabilities Act. During the construction period, CTA needed to close one of the four tracks along the busy segment between Fullerton and Belmont on Chicago's North Side, which accommodates the Purple and Red Lines as well as the Brown Line.[19] To meet the needs of riders whose travel was disrupted, CTA added buses on several routes in its north lakefront corridor, and Metra added trains on its Union Pacific North Line.
- Deteriorating ties on the O'Hare extension of the Blue Line, opened in 1983 and 1984, resulted in extensive slow orders by the middle of the first decade of the 21st century.[20] In 2008, CTA rebuilt the affected section, with extensive evening and weekend track closures and bus substitutions.
- Metra faces the need to rebuild aging, obsolete bridges carrying the Union Pacific North Line over 22 streets on Chicago's North Side. Metra's Union Pacific (UP) lines use the oldest locomotives in Metra's fleet because the North Side bridges cannot accommodate more modern locomotives which also have heavier loads per axle. Although the weight issue is confined to the UP North Line, commuter train consists are interlined between the UP North, Northwest, and West Lines in order to use equipment as efficiently as possible. Thus, all three UP lines must now use the oldest type of locomotive, and will benefit from newer locomotives once bridge reconstruction is completed. Metra has planned work so as to preserve two-track operation throughout the line during the eight-year construction period.[21] Although this will require more time and money to implement than single-tracking, it will minimize disruption on Metra's

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1402, Washington: Transportation Research Board, 1993.

[17] Allen, John G., Herbert S. Levinson, Graham C. Garfield, and Anthony Coppoletta, "South Over the Alleys: The Rise, Fall and Rebuilding of Chicago's South Side 'L'," in *TRB 88th Annual Meeting Compendium of Papers DVD*, Washington: Transportation Research Board, January 2009; also John G. Allen, Herbert S. Levinson, Bruce G. Moffat, and Graham C. Garfield, "Chicago's Lake Street 'L': Ups, Downs, and a Rebound," in *TRB 89th Annual Meeting Compendium of Papers DVD*, Washington: Transportation Research Board, January 2010.

[18] Gash, Sean M., Graham C. Garfield, and David C. Bollinger, "A Decade of the Red Line and Green Line," *First & Fastest*, Summer 2003, p. 15.

[19] Allen, J.G. and S.H. Abrams, "Chicago's North Side 'L': The First Hundred Years," in *Transportation Research Record 1793*, Washington: Transportation Research Board, 2002.

[20] Hinz, Greg, "What's wrong with the CTA?" *Crain's Chicago Business*, January 22, 2007.

[21] This is possible largely because the UP North Line formerly had three tracks between Clybourn and Davis St., Evanston. In 1981, predecessor railroad Chicago & North Western abandoned the westernmost of the three tracks as a cost-saving measure. The bridge reconstruction plans call for the restoration of the former track for northbound trains, and the ultimate abandonment of the easternmost track. The center track (now used for northbound trains) will, once reconstruction is complete, be used for southbound trains.

fourth-busiest line (and the one with the greatest reverse commuting).

- One of CTA's current major investment studies is of the future of the Red and Purple Lines on Chicago's North Side and in Evanston, Ill. An aging filled-earth embankment built between 1914 and 1922 carries the four tracks of the Red and Purple Lines between Lawrence (where a steel elevated structure ends and the embankment begins), Howard (the north end of the Red Line) and Evanston. The narrow right-of0-way slowed the process of building the embankments, and forced the rapid transit company to use concrete retaining walls on a widespread basis. CTA is seeking to determine what engineering alternative best ensures the future of this vitally important part of the network.[22]

Pressing needs remain at CTA and the other service boards, sometimes making themselves known unexpectedly. A 2007 rapid transit derailment attributed to an undetected track segment that was out of gage[23] caused both CTA and RTA (the state-designated rail safety oversight agency for CTA) to pay increasing attention to track inspection and other safety matters. The two agencies now work together on rail safety issues in an atmosphere of cooperative problem-solving.[24]

Aligning CTA's internal processes more closely with safety needs has been helpful, but deferred maintenance remains a very real issue. This has brought increased attention to the condition of the system.

Asset Condition Study

In 2007, RTA updated its strategic plan for the first time in over a decade.[25] With much of the conversation about regional transit in northeastern Illinois involving the system's capital investment backlog, it made sense for RTA to commission an assessment of the system's physical plant and rolling stock as a prelude to determining how best to prioritize limited capital for investment.

Assessing the condition of the transit system's capital assets was a logical outgrowth of the strategic plan, as a clear understanding of just what shape that system was in was a prerequisite for restoring it to a state of good repair. Although RTA and the service boards knew what the system's assets were, there was no precise inventory in existence, as all three service boards were making changes to their fixed plant and rolling stock, sometimes on an improvised basis.

With the encouragement of the Federal Transit Administration, RTA began a regional asset condition assessment in January 2009 and issued a report in August 2010, becoming one of the first transit agencies in the US to conduct a study of this nature. The *Regional Transportation Authority Capital Asset Condition Assessment* inventoried and assessed, as best as could be done without performing detailed engineering studies of large parts of the system, what the region's transit assets were and their condition.[26] All three service boards participated in all aspects of the study.

Study Process

The first step was to record all the system's assets. In order to make sense of the many different types of rolling stock and fixed plant items, it was necessary to group the various assets into five categories:

- Track and Structures
- Electrical and Subway Equipment
- Signals, Communications, and Fare Collection
- Stations, Garages, and Facilities
- Rolling Stock

Table 1 shows these categories in more detail.

The second step was to determine the condition of these assets. It was not feasible to establish the condition of all of the assets in civil engineering terms within the time and budgetary constraints of the study. Therefore, it was decided to use the age of the assets (to the extent that this could be determined) as a proxy for their condition. New assets were judged to be the

[22] "North Red and Purple Modernization Project Environmental Impact Statement Scoping Information," Chicago: Chicago Transit Authority, January 2011.

[23] *Derailment of Chicago Transit Authority Train Number 220 Between Clark/Lake and Grand/Milwaukee Stations, Chicago, Illinois, July 11, 2006*, Washington: National Transportation Safety Board, September 11, 2007; also Julian Wolinsky, "Putting the rapid back into transit," *Metro Report International*, March 2010, p. 20.

[24] "Effective Oversight of RTA Track Inspection Processes – A Case Study of the Chicago Transit Authority," *Rail Transit Safety Quarterly Newsletter* (US Department of Transportation), Summer 2009, pp. 8-13.

[25] *2007 – The Year of Decision: Regional Transportation Strategic Plan*, Chicago: Regional Transportation Authority, February 8, 2007.

[26] *Regional Transportation Authority Capital Asset Condition Assessment*, prepared for the Regional Transportation Authority, Chicago, August 2010.

TABLE 1 Types of Capital Assets Inventoried

Asset Groups	*Sub-Groupings*	*Specific Assets and Transit Operators Associated Therewith*
Track and Structures	***Track Structures***	Track Structures(CTA, Metra)
	Track	Ties (CTA, Metra)
		Rail (CTA, Metra)
		Grade Crossings (CTA, Metra)
		Special Trackwork (CTA, Metra)
Electrical and Subway Equipment	***Traction Power***	Substations (CTA, Metra)
		Substation Distribution (CTA)
		Right-of-Way Traction Power (CTA, Metra)
		Overhead Catenary Wire (Metra)
	Subway Equipment	Subway Electrical Service (CTA)
		Subway Fans (CTA)
		Subway Illumination (CTA)
		Subway Pumps (CTA)
Systems	***Signals***	Interlockings (CTA, Metra)
		Interlockings Owned by Railroads Operating Under Purchase- of-Service Contracts (Metra)
		Cab Signals (CTA)
		Signal Controls (Metra)
		Signal Controls Owned by Railroads Operating Under Purchase-of-Service Contracts (Metra)
		Grade Crossing Signals (CTA, Metra)
		Grade Crossing Signals Owned by Railroads Operating Under Purchase-of-Service Contracts (Metra)
	Fare Collection	Fare Collection Equipment (CTA, Metra, Pace)
	Communications	Radio Systems (CTA, Metra, Pace)
		GPS On-Board Bus (CTA)
		CCTV System at Rail Stations (CTA)
		Cable Plant (CTA, Metra)
		Fiber Optic Backbone Network (CTA, Metra)
		Station SCADA Systems (CTA)
		Electrical Substation SCADA RTUs (CTA)
		Public Address Systems – Audio (CTA)
		Public Address Systems – Vocal Management System (CTA)
		CCTV System for Ticket Vending Machines (Metra)
		CCTV System for Homeland Security (Metra)
		Telephone Systems (Metra)
		Public Address Systems (Metra)
		Microwave (Metra)
		Wireless Telephone (Metra)
		Electric Signal – ITS (Pace)
Stations, Garages, Facilities	***Stations and Parking***	Stations (CTA, Metra)
		Station Parking (CTA, Metra)
	Passenger and	Bus Passenger Facilities and Stations (CTA, Pace)
	Maintenance	Bus Garages (CTA)
	Facilities	Other Bus Maintenance Facilities (CTA)
		Bus Support Facilities and Equipment (Pace)
		Paratransit Support Facilities and Equipment (Pace)
		Rail Maintenance Facilities (CTA)
		Rail Yards (CTA)
		Maintenance and Yard Facilities (Metra)
		Agency Headquarters (CTA, Metra, Pace)

TABLE 1 Types of Capital Assets Inventoried (Continued)

Asset Groups	*Sub-Groupings*	*Specific Assets and Transit Operators Associated Therewith*
Rolling Stock	***Revenue Vehicles***	Electric Multiple Unit Cars (CTA, Metra)
		Diesel Locomotives (Metra)
		Coaches for Diesel Push-Pull Service (Metra)
		Buses (CTA)
		Non-Paratransit Vehicles (Pace)
		ADA Service Vehicles Other than Vans (Pace)
		ADA Paratransit Vans (Pace)
	Non-Rev. Vehicles	Non-Revenue Vehicles (CTA, Metra, Pace)
	Work Equipment	Work Equipment (CTA, Metra, Pace)

Notes:
ADA – Americans with Disabilities Act
CCTV – Closed Circuit Television
GPS – Global Positioning System
ITS – Intelligent Transportation Systems
RTU – Remote Terminal Unit
SCADA – Supervisory Control And Data Acquisition

Source: *Regional Transportation Authority Capital Asset Condition Assessment*, Aug. 2010, p.7.

highest rated at 5-in excellent condition. Other assets were rated in descending order, according to their age, as a general approximation of the useful life of the particular type of asset. These ratings were 4-good, 3-fair, 2-poor and 1-beyond useful service life. Assets in the latter category were judged to be in need of replacement, and are characterized as "backlogged," i.e., awaiting investment in the system's capital stock.

To verify that the age interpolation process was consistent with the system's true condition, a sampling was made of approximately 1% of the assets, chosen so as to include the most relevant major asset categories for each service board. The sampling process raised no serious questions about the validity of using age as a proxy for condition, although exceptions exist on large and complex systems such as Chicago's. Some well-maintained older assets may be in better shape than their age would suggest. Conversely, certain newer assets may have deteriorated faster than their years would indicate. The report, therefore, should not be taken as a precise assessment of the condition of specific assets. Instead, the study is most useful as an overview of the condition of northeastern Illinois' transit system in the aggregate.

Third, the replacement costs for the various assets were estimated. Input information for this process included purchase price, age, and depreciation rates. Professional judgment based on experience was used, along with research into the replacement costs of certain specific assets.

Fourth, replacement costs were determined for all assets that had reached life expiry. Fifth, ten-year normal replacement costs between 2010 and 2019 were established. Sixth, capital maintenance costs for the same period were established. Finally, these costs were added to produce a total ten-year state-of-good-repair need.

Findings

Using a rating scale from 5 (excellent condition) to 1 (beyond useful service life), the state of the region's main groups of transit assets was found to be:

- Rail Passenger Cars: 2.29, with nearly 42% beyond their useful life. To bring the rail fleet into a state of good repair, 931 of the 2,225 cars would have to be replaced, and the remaining fleet would have to be maintained at a state of good repair. Figure 1 shows the categories for rail passenger cars.
- Rail Stations: The rating of 3.00 belies the finding that over 39% of the stations were rated at 1 (beyond useful service life). At least 150 of the region's 382 rail stations would have to be renovated, with appropriate replacement and

capital maintenance performed at the other stations.

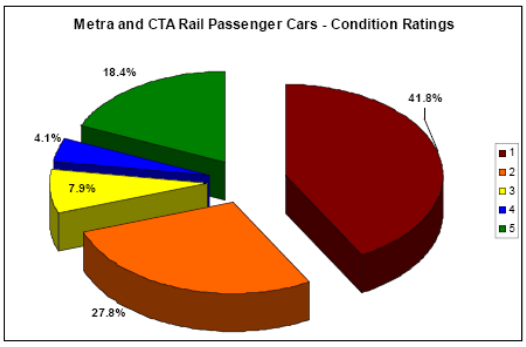

Figure 1: Condition of Rail Passenger Cars (Source: Regional Transportation Authority Capital Asset Condition Assessment, Aug. 2010, p. vi.)

- Rail Bridges and Structures: The 3.26 rating appears fairly positive at first glance, but this figure conceals the fact that 11% of the bridges and structures are beyond their useful service life. At least 151 of the 1,361 bridges and structures would have to be renovated between 2010 and 2019 to bring them into a state of good repair, and the many remaining elements would have to be well maintained. Figure 2 shows the categories for rail bridges and structures.

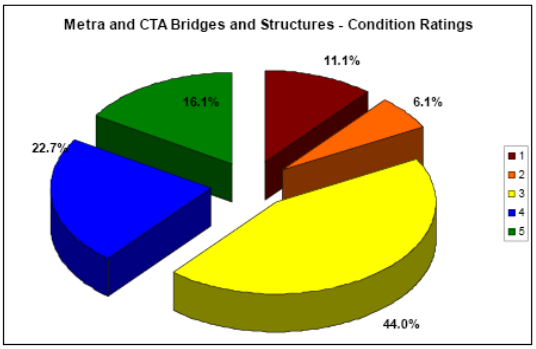

Figure 2: Condition of CTA and Metra Rail Bridges and Structures (Source: *Regional Transportation Authority Capital Asset Condition Assessment*, Aug. 2010, p. vi.)

As an example of the differences in condition among assets of the same type, Figure 3 shows a rapid transit viaduct in excellent condition (5-rating) and Figure 4 shows another beyond its useful service life (1-rating).

- Fixed-Route Buses: 3.46 for the bus fleet overall, with two-thirds in a state of good repair. This implies the need to replace at least 457 of the region's 2,918 buses, and maintain the others at a state of good repair. Figure 5 shows the categories for fixed-route buses.

Figure 3: Rapid Transit Viaduct in Excellent Condition (Church St., Evanston, CTA Purple Line; RTA photo)

Figure 4: Rapid Transit Viaduct Beyond Useful Service Life (Hollywood Ave., Chicago, CTA Red Line; RTA photo)

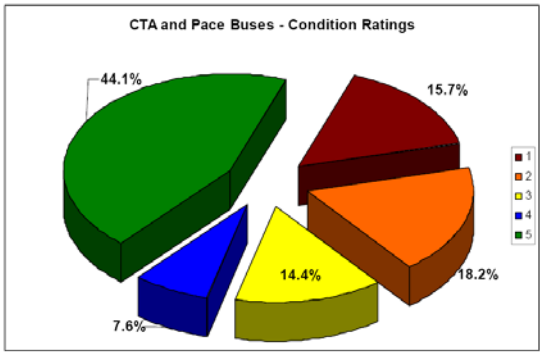

Figure 5: Condition of CTA and Pace Fixed-Route Buses (Source: *Regional Transportation Authority Capital Asset Condition Assessment*, Aug. 2010, p. vii.)

- Rail Maintenance Facilities: Rail car and locomotive shops were rated at 3.64 overall. Of these, 14% are rated at 1 (beyond their useful life) and another 8% are rated at 2 (marginal). To bring the rail maintenance facilities into a state of good repair, at least 5 of the 36 will have to be renovated, and the others properly maintained.
- Bus Maintenance Facilities: 3.37 overall, with 16% rated beyond their service life and another 16% rated marginal. At least 3 of the 19 facilities will need to be replaced, in addition to maintaining the other garages at a state of good repair.

Several cost components were identified in conjunction with the system's capital stock:

- The *backlog* of assets that have passed their useful service lives and for which replacement is therefore indicated. This amounts to $13.8 billion for the region ($10 billion for CTA, $3.7 billion for Metra, and $100 million for Pace).
- *Normal replacement costs* for assets expected to reach the end of their service lives between 2010 and 2019 come to $6.8 billion regionwide ($3.2 billion for CTA, $1.7 billion for Metra, and $1.9 billion for Pace).
- The cost of keeping assets in a state of good repair, referred to as the *capital maintenance component*, comes to $3.9 billion regionwide ($1.7 billion for CTA, $1.9 billion for Metra, and $200 million for Pace).

Soft costs covering engineering, planning and project management were added to the totals, as were contingency costs for unforeseen eventualities such as the discovery once work is under way that the original specifications for rehabilitation or replacement do not meet the project's needs.

The study projected a ten-year capital need of $24.6 billion between 2010 and 2019, or $2.46 billion annually, to bring the entire northeastern Illinois transit system to a state of good repair and keep it there. Of this amount, CTA's needs amount to 61%, Metra's needs 30%, and Pace's needs 9%.

Even aside from the fact that assessing the condition of the physical plant is a *de facto* precondition for federal funding, RTA believes this course of action is both right and cost-effective. The study cost $1.2 million to perform, and it will cost another $300,000 to update the data over the next five years (just over 1/1000 of a percent of the annual cost of rehabilitating the system).

The study gives RTA better information to prioritize projects within resource constraints. There are quantifiable benefits both in the ability to reduce operating costs associated with deteriorating assets, and in the ability to retain and attract customers when the system is in good condition.

These capital needs are reasonable compared to the net replacement value of the capital assets of CTA, Metra and Pace throughout northeastern Illinois. Before the study, RTA had been estimating the system's replacement value at $35 billion, but this now appears to fall far short of the true cost of rebuilding or replacing the entire physical plant. The study determined the net replacement value of the total capital assets used by the three service boards to be around $140 billion in 2010 dollars. This includes an estimated $100 billion for the structural components of the subways used by CTA's Red and Blue Line trains.

Cooperation With Federal Transit Administration

The RTA's asset condition assessment is relevant beyond northeastern Illinois. In 2008, the Federal Transit Administration (FTA) issued a report, *Transit State of Good Repair: Beginning the Dialogue*, in which FTA estimated that around a fourth of the capital assets of all US transit properties are near or beyond the end of their useful service lives.[27] A 2009 *Rail Modernization Study* examined the assets of seven rail transit agencies and found only 30% of their assets (weighted by value) to be in good or excellent condition. Fully 35% were in marginal or poor condition, and the remaining 35% were in adequate condition.[28] FTA has remained an active participant in the conversation about state-of-good-repair (SOGR) issues.[29]

As RTA's *Capital Asset Condition Assessment* was being funded by FTA, RTA decided to use the same categories and terms as FTA. This helps the RTA's assessment to fit into FTA's analytical framework, allowing FTA officials to readily evaluate RTA's study and see how it fits in with FTA's SOGR efforts. In some instances, similar assets are broken out differently for dif-

[27] *Transit State of Good Repair: Beginning the Dialogue*, Washington: Federal Transit Administration, October 2008.
[28] *Rail Modernization Study: Report to Congress*, Washington: Federal Transit Administration, April 2009, p. 2.
[29] *2010 National State of Good Repair Assessment*, Washington: Federal Transit Administration, June 2010.

ferent service boards, but all assets are categorized according to FTA's framework.

RTA sees its asset condition assessment as an important analytical method worth sharing among the professional community. RTA delivered a presentation about its asset condition assessment at a July 20-22, 2011 workshop in Atlanta, Georgia about SOGR issues, and at FTA's request, distributed copies of the assessment to representatives of other transit systems.

Ongoing Process

Although the *Capital Asset Condition Assessment* is a major step towards guiding the Chicago area's transit system toward a state of good repair, RTA views this as just a beginning. In cooperation with FTA, RTA will be updating the assessment over the next five years. Each year, engineering studies will be performed on more assets, which will help RTA update the estimated replacement value of the system and make the figure more precise, with less reliance on professional judgment (however experienced this may be) and more on physical inspection of assets.

In particular, RTA anticipates an improvement in the precision of the data on Metra's physical plant. As of this writing, Metra is arranging to bring in contractors to conduct an asset inventory, the results of which will help inform RTA's ongoing work.

Looking beyond the five-year framework of the current asset condition assessment work plan, RTA seeks to make the updating process an ongoing part of its oversight role. Assets will continue to age and wear out, which makes asset condition management a vitally important prerequisite for any transit system seeking to reach (and stay at) a state of good repair.

RTA is also incorporating capital asset condition assessment data into its regional transit performance measures.[30] RTA monitors, as part of a broader, ongoing process, service maintenance and capital investment indicators, including state-of-good-repair issues. At this writing, RTA is developing a performance measure for asset condition, based on the percent of assets in a state of good repair (3 or above in the rating scale), and is quantifying the cost of bringing the substandard elements up to a state of good repair. Given the need for rolling stock and fixed plant alike to support reliable operations, RTA sees this as an important aspect of the performance measurement process.

From Inventorying to Prioritizing

However important it is for transit agencies to know about the condition of their assets, it is even more important for them to use this information in order to prioritize the use of scarce resources. RTA, New York's MTA, and the Los Angeles County Metropolitan Transportation Authority are currently working with a contractor to develop a decision tool for use in prioritizing investment in the system. The decision tool will use the asset condition assessment as its data base. It will allow agencies to evaluate alternative uses for capital funds according to various criteria, such as maintaining safety, enhancing security, and reducing operating costs.

CONCLUSION

An asset condition assessment such as the RTA's is a vitally necessary step in addressing SOGR challenges. The RTA's assessment shows how to categorize and cost assets, and determine the system's ten-year SOGR needs.

The ongoing interest in asset management at transit authorities reflects the fact that large transit properties, particularly historically-established systems, must be brought up to and kept in a state of good repair to the maximum extent possible. As assets wear out, they need to be either rebuilt or replaced, and a failure to do so before the situation becomes serious may affect the system's operating reliability. In an institutionally complex setting, Chicago's RTA has taken the lead in assessing the condition of northeastern Illinois' transit assets in order to promote a regional conversation about prioritizing scarce capital to best address the system's many pressing needs.

The views are those of the authors, and do not necessarily reflect the official policy of any organization.

[30] Grace Gallucci and John G. Allen, "Regional Transit Performance Measures at Chicago's Regional Transportation Authority," in *TRB 90th Annual Meeting: Compendium of Papers DVD*, in Washington: Transportation Research Board, January 2010.