



TSSA Elevator Availability Study

Final Report

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Executive Summary

There are almost 20,000 passenger elevators across more than 10,000 residential and institutional buildings in Ontario.¹ Elevators are often the only way for residents to access their homes, for first responders to reach emergencies, or for people to reach their daily destinations efficiently. These elevators are used in a variety of ways depending on the building, population, location, and a host of other factors. Consider the rental tenant accessing their home, the retirement home resident in a wheelchair going to a medical appointment, or the condominium owner who expects good service in their new building.

As the existing stock of elevators ages and the province experiences a rapid growth in construction of buildings (including high-rise condominiums), elevator availability is under increasing scrutiny. Over the past few years, stakeholders across Ontario have raised a variety of issues related to elevator availability, including:

- Public and worker safety
- Accessibility for users, access to homes, and access for emergency responders
- Cost and speed of maintenance
- Slow repair times and long elevator outages
- Owner and user knowledge of elevators as a key asset
- Entrapment and emergency response processes
- Labour supply of elevator mechanics
- Fair and open markets for contractors
- Impact of regulation of the elevator industry

The topic of elevator availability has been covered in a variety of mainstream media in recent months, and has garnered political attention.² In March 2017, MPP Han Dong tabled a private member's bill, *Bill 109, Reliable Elevators Act, 2017*, in the Ontario legislature. It has now passed second reading and been referred to the Standing Committee on Regulations and Private Bills. The bill (in its present form) will require a person who applies for a permit to construct a building with seven or more storeys to show that the building will have enough elevator capacity. It will also require an elevator that breaks down to be repaired within 14 days for most residential buildings and seven days for long-term care homes and retirement homes. Finally, the bill calls for more robust and widespread elevator usage studies for new buildings. The MPP acknowledges that much of the input he received was anecdotal and is open to a more robust, evidence-based set of recommendations relative to this topic.

To respond to emerging concerns associated with elevator availability and the lack of data on the topic, the Technical Standards and Safety Authority (TSSA), in partnership with the Ministry of Government and Consumer Services (MGCS) and the Ministry of Municipal Affairs (MMA), have engaged Retired Superior Court Justice Douglas Cunningham to author this independent study, with support from Deloitte's Public Sector Strategy team.

The purpose of this study is to define and assess the state of elevator availability in Ontario, identify key drivers of issues with availability, and propose a series of solutions (both regulatory and non-regulatory) to inform policy discussions.

¹ TSSA data. Examples of residential buildings include condominiums, rental housing, or student residences, while institutional buildings include retirement homes, long-term care homes, and other group homes. This study has focused on institutional buildings with long-term residents. Hospitals and other short-term health facilities fall outside the scope of the study.

² As the core component of this study, the proposed definition of "Availability" is discussed in detail in Section 2. Where the term "Availability" is not explicitly defined in this report, as availability is understood in a general sense as *the reliable functioning and timeliness of an elevator*.

This fourteen-week assessment included a jurisdictional scan of peers to Ontario, a series of over 50 interviews and workshops with stakeholders, a primary research survey sent to more than 3,000 elevators owners and operators in Ontario, risk-based assessment of TSSA data, and analysis of TSSA, long-term care home, and municipal data.

A Brief Overview of the Sector and its Stakeholders

While the elevator sector touches a broad set of stakeholders across the province, robust data on elevator availability is either not shared across stakeholders or not available at all.

For those assessing availability in the province, the needs and interests of this broad set of stakeholders should be understood. While a detailed overview of stakeholders exists in the report, they include:

- **Elevator Users:** Users of the 19,900 residential and institutional elevators in Ontario take approximately 655,000 elevator trips a day.³ These users include tenants of rental buildings, condominium owners, or people using a hospital, assembly, school, or other public facility. They also include seniors, persons with mobility issues, and residents completing daily tasks.
- **Elevator Owners:** Every device in Ontario has a licensed owner. The license holder could be the building owner – the rental property owner, the condominium corporation – or the building owner's representative - the property management company representative or building manager. The owner is responsible for the safe operation and maintenance of the elevator as well as any reporting on its status.
- **Elevator Manufacturers:** Elevator manufacturers build elevators and construct elevator parts. They continue to innovate with elevator technology to improve the safety and efficiency of elevators. Four large manufacturers serve the majority of the Ontario market: Kone, Otis, Schindler, and ThyssenKrupp.
- **Elevator Contractors:** Elevator contractors employ 3,500 mechanics in Ontario to maintain and repair elevators.⁴ Elevator contractors must be registered with the TSSA and report on the installation number, class, location, and scope of maintenance for each device under their authority. The TSSA also administers testing and certification of elevating device mechanics.
- **Elevator Consultants:** Elevator consultants have emerged in Ontario over the past 20 years as a response to the increasing need for elevating devices in high-rise buildings. Consultants specialize in the design and scoping of elevators. They may advise developers and architects on product selection or help owners of existing buildings to understand service and maintenance needs.
- **Building Industry:** This group includes the architects, developers, engineers, municipal chief building officials, and building inspectors who are involved in the design and regulatory oversight of the construction and / or renovation of a building.
- **Technical Standards and Safety Authority (TSSA):** TSSA is a statutory corporation with delegated authority to administer and enforce public safety laws and regulations in designated sectors under the province's *Technical Standards and Safety Act, 2000* and associated regulations, including those applying to elevating devices. The TSSA works to investigate incidents and enforce safety while also focusing on prevention through informing and educating end-users and industry regarding safety requirements. The TSSA delivers activities through a "fee for service" cost recovery model.
- **Ministry of Government and Consumer Services:** Among other responsibilities, the Ministry of Government and Consumer Services oversees the TSSA and has a mandate to strengthen consumer protection and public safety for Ontarians.

³ Calculated based on National Elevator Industry, Inc. estimates for passenger trips per day.

⁴ TSSA data.

- **Ministry of Municipal Affairs:** In addition to other responsibilities, the Ministry of Municipal Affairs administers Ontario's Building Code. The Code provides guidance and detailed technical and administrative requirements for building construction, including for elevators. The Code is forward-looking and does not apply retroactively. Under the Building Code Act, 1992, enforcement of the Code is the responsibility of local bodies, primarily municipal building departments.
- **First Responders:** First responders, including firefighters, paramedics, and police, are responsible for addressing emergencies in a timely and efficient manner. Lack of elevator access can be a significant barrier to their ability to quickly respond to and address an emergency, potentially introducing health and safety risks for residents.

The Fact Base on Elevator Availability

Access to data and communication across organizations and individuals in the sector is relatively weak. While TSSA does have robust safety data, information on availability is sparse. The availability data that does exist provides a mixed picture of the state of availability in Ontario. Some industry parties are proud of recent achievements regarding availability, while others expressed concern.

Some data points on elevator performance are positive:

- Industry across North America strives to ensure devices are available 98% of the time and one estimate indicates that devices in residential and institutional buildings in Ontario were available an average of 99% of the time in 2016⁵
- Data aggregated from a majority of contracting companies shows that most elevators in Ontario are repaired within 24 hours; approximately 1% of Ontario devices across office, residential and institutional buildings experience outages longer than a week over a given year⁶
- The number of service calls for elevator repairs in Ontario has decreased by 15% over the past three years; the number of entrapments recorded by contractors has decreased by 18%-20% over the same period⁷

Other data received, however, indicates that Elevator Availability is in fact an issue:

- Estimates based on TSSA data and expert analysis place average availability across residential and institutional buildings at 97%, or 3% non-availability, the equivalent of 10 days out of service⁸
- One out of five surveyed building owners in Ontario reported availability of less than 95% over the past year, the equivalent of approximately 18 days or more out of service. Most buildings with low availability were in the Greater Toronto Area, also the location with the most elevators in the province. Condominiums surveyed reported the lowest average availability by building type, at 93% out of the year. No observable patterns were found in the age of the elevator⁹

⁵ Data from National Elevator and Escalator Association membership reported 99.2% operational time over the past year.

⁶ The National Elevator and Escalator Association and industry experts consulted estimate that 98% of elevators are returned to service within 24 hours. Survey findings may differ based on sample of building owners reporting on the survey. National Elevator and Escalator Association. (September 2017). *Reliable Elevators – How Ontario Can Become a National Leader for Transportation Systems in Buildings.*

⁷ Ibid.

⁸ Fault-tree analysis conducted on TSSA data and expert input from contractors, inspectors, and TSSA data analysts estimated that passenger elevators in residential and institutional buildings in Ontario were operational 97% of the year. Note that risk assessment, survey, and contractor data may vary based on the sample population. Contractor data on average availability across the province may not include records from every contractor, while survey and risk assessment estimates are based in large part on expert opinion and reported estimates, respectively, and may represent a subset of buildings.

⁹ Eight of ten surveyed license holders reported their device was operating over 95% or more of the past year. The survey was distributed directly to 2,942 institutional and residential passenger elevator license holders across

- Of 250 survey respondents, 4% reported experiencing outages that lasted longer than three weeks over the past year. No observable patterns were noted in building type, building capacity, or age of device¹⁰
- Contractors responded to 9,649 elevator entrapments in 2016 across residential and institutional buildings, the equivalent of over 26 elevator entrapments per day in Ontario¹¹
- 80% of residential and institutional buildings in Ontario have only one or two passenger elevators, creating concern around availability and accessibility if even one device is out of service (whether for regular maintenance, tenant use for moving, or other circumstances)¹²
- Despite the current construction boom, builders have no formal obligation from the Building Code or other mechanisms to invest in elevator capacity to a common standard

In order to set the Ontario landscape in context, we conducted a jurisdictional and media review to assess how other global jurisdictions are approaching elevator availability. Research was conducted across six municipal or regional jurisdictions with rapid or comparable growth in high-rise density to Ontario as a whole as well as international standards organizations, transit authorities, Canadian municipalities, state-level regulatory bodies, and private sector groups addressing the topic of elevator availability.

Overall, there is widespread recognition of the importance of timely and operational elevators. Although there are various global initiatives underway to study availability at the international, national, and sub-national level, there is comparatively **limited public policy and regulation governing elevator availability across other jurisdictions.**

Most notably, there is no proactively enforced regulatory definition for “Availability” in place. International standards-setting bodies, transit authorities, private sector actors, and open data platforms define availability, based on the amount of total time a device is operational. Market-based mechanisms, such as the contract between elevator owners and contractors, are typically used to drive elevator service standards. A range of municipal property standards in Ontario require elevators be kept operational and in good repair, although it is within the discretion of inspectors to determine whether the standard has been met.

An “Ideal” Future State of Elevator Availability

To respond to emerging concerns associated with elevator availability, I considered a broad set of input from relevant organizations and individuals as well as jurisdictional trends and developed a view of what the “ideal state” of elevator availability in the province would look like. The following table contrasts aspects of this “ideal” state with what we learned about the current state of the sector in Ontario.

Ontario as well as through communications from building owner associations. The survey totalled 15 questions and was in the field for three weeks. 250 license holders responded. Survey results achieved a confidence level of 95% with an interval of 0.06. Please note: not all respondents submitted a survey with responses to all the questions. Responses with the majority of questions answered were used for analysis. All survey data is reported and relies on estimates.

¹⁰ Based on the Deloitte survey of license holders for devices in residential and institutional settings across Ontario. For a note on discrepancies between data sources, see Note 8.

¹¹ National Elevator and Escalator Association. (September 2017). Reliable Elevators – How Ontario Can Become a National Leader for Transportation Systems in Buildings. Note that contractor data indicates entrapments have decreased by 18 percent over the last four years in Ontario.

¹² Calculated from TSSA datasets; Elevating Device License by Installed Device Number (<https://www.tssa.org/corplibrary/ArticleFile.asp?Instance=136&ID=D01283642B5911E7B91F005056AD4CB7>) and building type from Risk-Based Decision Data (<https://www.tssa.org/corplibrary/ArticleFile.asp?Instance=136&ID=97C3A5772B5711E7B91F005056AD4CB7>)

Ideal Scenario	Current State
<p>A consistent and clear definition of elevator availability facilitates accurate and informed regulation and policy making on the state of availability.</p> <p>An organization or coordinated network of organizations within the broad purview of the Government of Ontario have clear accountability for measuring and managing "Availability" across residential and institutional buildings in Ontario.</p>	<p>There is no commonly accepted definition of availability and an absence of publicly available information and data on the current state.</p> <p>No public sector organization currently manages availability across residential and institutional buildings. Accountability for related concepts, including the reliability, safety, operability, and accessibility of elevators, is distributed across the OPS, broader public sector, and municipalities.</p>
<p>Preventative maintenance is performed on a regular basis and in compliance with all safety and availability regulations.</p>	<p>There are currently no minimum preventative maintenance standards, which appears to be undermining availability. Compliance with minimum maintenance standards <i>for safety</i>, shown to signal more effective preventative maintenance practices, is at an all-time low.</p>
<p>Repairs are conducted as quickly and efficiently as possible given the nature of the issue while balancing user and owner interests. Severe repair delays (over 48 hours) are reported to the accountable regulator and monitored.</p>	<p>Some buildings are left with partial or no elevator service for long periods. Reasons for prolonged outages are often complex and can include lack of parts availability, lack of mechanic availability, or delays in authorizing repair.</p>
<p>Entrapments are rare and resolved quickly through rapid communication with appropriate parties who ensure that passengers can safely exit the elevator car.</p>	<p>According to the National Elevator and Escalator Association, contractors documented approximately 9,649 entrapments across residential and institutional buildings in Ontario or about 26 per day in 2016.¹³ Ontario firefighters responded to 4,467 calls for entrapments across all building types, or about 12 per day, in 2015, representing 1% of all calls responded to by Ontario fire services.¹⁴ While entrapments are rare, there is a lack of clarity around communication and accountability between owners, firefighters, and elevator contractors in circumstances involving entrapment, contributing to the discrepancy in contractor and firefighter data.</p>
<p>As a source of elevator industry knowledge and expertise, TSSA promotes and undertakes activities including data collection, registration, training, inspections, and enforcement to enhance public safety.</p>	<p>Despite a solid reputation for ensuring safety, industry parties expressed concern regarding consistency of regulations and effective communication with the industry.</p> <p>Industry believes they have channels for input but have not been adequately engaged in</p>

¹³ National Elevator and Escalator Association. (September 2017). Reliable Elevators – How Ontario Can Become a National Leader for Transportation Systems in Buildings.

¹⁴ Data from Office of the Fire Marshal and Emergency Management, coded as "person trapped in elevator".

Ideal Scenario	Current State
<p>Acting as a “Modern Regulator” and incorporating broad and frequent industry input into its decision-making, TSSA collaborates with industry on key technical and strategic matters affecting the industry.</p> <p>As in any relationship between industry stakeholders and a regulator, mutual trust is an important component.</p>	<p>strategic decision-making on technical issues. They see this as a lost opportunity for the TSSA.</p> <p>The TSSA expressed strong views that accountability for availability cannot reside within their current mandate, which is focused on safety. They say linkage of these two concepts could impede current processes and lead to a weakening of Ontario’s strong record for safety.</p>
<p>Market-based competition is driven by user choice, with active and informed users putting pressure on contractors to improve services. Contracts facilitate a “fair” marketplace: while minimum service standards are in line with owner expectations, there is an opportunity for higher value “premium” services for those willing to pay more.</p>	<p>Some owners may lack the technical knowledge and expertise to negotiate balanced contracts or advocate for improved service. Some owners report service standards not meeting minimum expectations while some stakeholders report that price competition has resulted in significantly curtailed maintenance services.</p>
<p>Building owners include adequate maintenance and modernization in long-term capital and other financial planning.</p>	<p>Building owners may defer modernization or engage in less comprehensive maintenance service packages due to cost. Owners are often unaware of or unprepared for the cost of maintenance or replacement over a device’s lifecycle.</p>
<p>All new buildings are equipped with elevator capacity sufficient to transport the current and anticipated building population in a timely manner at high peak time, following a standard, transparent, and repeatable process.</p>	<p>There are limited requirements for the number of elevators that must be installed in a residential or institutional building at the time of construction (e.g., while there is a requirement for a firefighter’s elevator in high buildings, or as part of a barrier-free path of travel there is no requirement for a specific number of standard passenger elevators). While some builders use third party elevator consultants for advice on the number of elevators required for a building, methodologies may vary. This means that results are not standardized and do not necessarily assure the same level of service.</p>
<p>There is a sufficient supply of highly skilled and qualified mechanics available to provide services as required. A clear pathway to support apprenticeship completions and certification is in place.</p>	<p>The number of Class A elevating device mechanics has not kept pace with growth in the number of elevating devices and elevating device trainees. Multiple stakeholders report a lack of qualified mechanics employed and able to respond efficiently to calls for service.</p>

Ideal Scenario	Current State
In cases of emergency, first responders are able to access the person in distress as quickly as possible.	Currently, all emergency personnel have access to a universal service key located in the building or provided by the on-site building supervisor. Some fire services equip frontline vehicles with their own universal key. Other fire services and first responders such as paramedics must retrieve the key from the onsite building manager or building owner, potentially resulting in delays to emergency response time.

Recognizing that a significant gap exists between the ideal and the current state in Ontario, we then examined the root causes of this gap and the viability of regulatory and non-regulatory solutions to improve the state of availability.

We heard very clearly that solutions need to be focused on five core outcomes:

- Maintaining and enhancing public safety of elevators to build upon Ontario’s strong track record
- Creating a barrier-free Ontario through greater elevator availability
- Enhancing user satisfaction with elevator service and public confidence in the regulatory and market system
- Supporting housing affordability and suitability through smart regulation and a balanced, effective marketplace
- Promoting business enablement by introducing regulations where needed and where the benefit outweighs the cost

Summary of Six Themes and Related Recommendations

A total of 19 detailed recommendations are outlined in this report and are grouped under six broad themes:

1. Defining and measuring “Elevator Availability”
2. Enhancing preventative maintenance and outage management
3. Developing improved education and awareness for elevator owners on key availability topics
4. Developing guidelines for the capacity of elevators required in new buildings
5. Reviewing regulations and industry practices to enhance labour mobility and availability
6. Providing reliable elevator access for first responders

A table summarizing all 19 recommendations follows this executive summary.

Defining “Availability”

The first step in any amendment to policy and / or regulation is a definition and measurement process for “availability”.

Some components of availability in the elevator sector appear to relate purely to “convenience”. For instance, residents may have to wait longer periods for an elevator to arrive during busy times of the day, or may have to take several flights of stairs to reach their high-rise apartment if an elevator is out of service and they cannot wait. Both of these examples of weak availability certainly cause inconvenience, but common sense says that they are not true safety concerns.

However, some aspects of “availability” do appear to have the potential to impact safety. For instance, first responders may be unable to reach an emergency patient in a timely manner due to lack of

elevator service. An elderly or disabled person may not be able to leave their home to access a medical appointment if all elevators are out of service. It should be noted that there is no empirical evidence that a lack of availability poses a safety risk, when compared against other potential risks monitored by the TSSA.¹⁵ Technical elevator safety is well regulated and managed in Ontario. Many stakeholders, however, may perceive availability as related to safety.

A key component of availability, related to both convenience and safety, is accessibility. While, as mentioned, there is a lack of evidence that non-availability in Ontario today poses a significant risk to safety, common sense tells us that every out of service elevator makes a building partly or wholly inaccessible. Without elevator service, many residents cannot go to work, conduct daily activities, or access their home. Ontario is committed to removing barriers for people with disabilities and Ontarians more broadly in all aspects of public life. Enhancing elevator availability needs to be a part of this effort.

These examples illustrate that the impacts of elevator availability lie across a continuum, sometimes very close to and perhaps part of “safety” and sometimes much more related to “convenience”. While one might be tempted to define some aspects of availability under the broader term “safety”, a number of considerations need to be assessed in detail, such as:

- The empirical evidence that a lack of availability does not appear to directly or pose an unacceptable risk of fatality or injury¹⁶
- The perceived conflict that ensuring both safety and availability might pose to stakeholders such as TSSA inspectors

Concerns have been raised that from an empirical standpoint, availability has not been linked to safety. Nevertheless, many of those we consulted considered elevator availability to be an accessibility issue. From their perspective, there is an availability issue in the province today that needs to be proactively managed. It should also be noted that accessibility has been adopted as a key priority by the Government of Ontario and refers to ensuring a barrier-free province for all residents. Efforts should be made to ensure *accessibility* in all situations, as both a safety and convenience issue.

Having considered a number of options based in international standards, industry practice and, most importantly, user expectations, I recommend defining availability as:

“The ability of a building’s elevating devices to transport persons as and when required”.

This definition can be measured as a combination of the capacity of a building’s devices to transport a given number of users (i.e., its handling capacity) and the building devices’ collective uptime (the percentage of time at least one device is operating and available for use).

The first step towards applying or regulating this definition of availability is to obtain a better understanding of the current state. While the public sees availability as an issue in Ontario, it has been a challenge to obtain comprehensive, robust data on uptimes, elevator capacity, and other related measures across building types and regions. Government and industry need to collaborate to complete the picture of the state of availability and set expectations for availability on an ongoing basis.

Safety should always be the number one priority.

¹⁵ The TSSA uses risk of injury or fatality as a measure of acceptable risk from a given activity, calculated using the Disability-Adjusted Life-Years (DALY) metric, a universal health impact metric introduced by the World Health Organization. Preliminary analysis estimates elevator non-availability to have an individual risk of injury or fatality (fatality equivalent) of 0.07 per million people per year, compared to typical risk acceptability criteria of 1 fatality equivalent per million people per year for the general population and 0.3 per million people per year for vulnerable populations (e.g., seniors, persons with health issues). A threshold of 0.5 per million people per year warrants investigation. For more information on methodology, please refer to the TSSA Annual State of Public Safety Report (<https://www.tssa.org/corplibrary/ArticleFile.asp?Instance=136&ID=A6BA4558687E11E5ABDF005056AD4CB7>). Please see Appendix D for detailed methodology and approach.

¹⁶ See Footnote 15.

Any measures put in place to define and enhance availability should be in the context of safety. This objective should always be the top priority for all stakeholders. It must be noted that the TSSA strongly believes that management of safety and availability by the same entity, staff, and processes might in fact compromise safety. This report demonstrates how a variety of improvements to availability may be realized in the interest of accessibility, without compromising and, in fact, perhaps enhancing safety.

Considerations for Implementation

In order for these recommendations to be successful, I believe the following considerations should be assessed:

- The capacity of all industry participants to provide robust and comparable data relevant to availability without negative impact to their proprietary interests
- The priority placed on evidence-based policy even if that imposes reasonable delays on the timing of *Bill 109, Reliable Elevators Act, 2017* or any similar initiatives related to this topic
- The ability of all stakeholders to drive towards and be accountable for the five core availability outcomes
- The effectiveness of communication, education, and collaboration among industry, government, key stakeholders, and the broader user population
- Further analysis of the option of TSSA taking responsibility for availability, without compromising safety. This would include legal and operational reviews and discussions with senior TSSA management
- The ability of all organizations accountable for availability-related initiatives to build capacity for any new activities
- The coordination of standards and regulations across Canadian jurisdictions

I believe the 19 recommendations included in this report reflect the spirit and intent of *Bill 109, Reliable Elevators Act, 2017*. As I have noted, *Bill 109* is based, for the most part, on anecdotal evidence. This study is intended to present a more balanced view and offers a number of options to improve elevator availability that could be even more effective, efficient, and pragmatic than the solutions proposed in the current Bill.

Detailed Report Structure

The following sections expand on this executive summary, first providing an overview of the study purpose, scope and approach. Recommendations are organized by key themes. Each theme contains an ideal scenario, an overview of the current state, and regulatory and non-regulatory options describing how to address the gap between the two. Finally, I offer some considerations for implementation.

A glossary of terms as well as additional detail on our stakeholder consultations and research are included as appendices.

Recommendation Overview

Ideal scenario	Current State	Recommendation	Intended Impact on Availability	Implementation
Theme 1: Defining and measuring “Elevator Availability”.				
<p>A consistent and clear definition and reporting of elevator availability facilitates accurate and informed regulation and policymaking and communication to stakeholders.</p> <p>An organization or coordinated network of organizations within the broad purview of the Government of Ontario have clear accountability for measuring and managing “Availability” across residential and institutional buildings in Ontario.</p>	<p>There is no commonly accepted definition of availability, and an absence of industry or publicly available information and data on the current state.</p> <p>No public sector organization currently manages availability across residential and institutional buildings. Accountability for related concepts, including the reliability, safety, operability, and accessibility of elevators, is distributed across the OPS, broader public sector, and municipalities.</p>	<ol style="list-style-type: none"> 1. Define availability as “the ability of a building’s elevating devices to transport persons as and when required”, as measured by the handling capacity and uptime of a building’s system of devices 2. Conduct greater exploration of the links between safety and availability (including accessibility) and the implications across stakeholders 3. Assess whether TSSA, as opposed to other options, should be responsible for the management of Elevator “Availability” in addition to its current safety mandate 4. Require contracting companies to report data on all downtime. This metric will cover all outages from safety-related matters to regular scheduled maintenance 	<ol style="list-style-type: none"> 1. Defining availability will allow for consistent measurement and reporting to inform regulation and policymaking going forward 2. A greater understanding of the health and safety impacts of availability will best target regulatory and non-regulatory solutions for availability issues 3. Clear accountability for availability will clarify responsibilities for stakeholders, including building owners, and streamline any current and future measurement, monitoring, and regulation 4. Mandatory reporting will support the measurement of availability to assess the current state and potential solutions to issues going forward 	<p>Medium-term (6 - 12 months)</p> <ul style="list-style-type: none"> • Assessing the viability of TSSA (or another body) taking responsibility for “Availability” will require additional data collection, operational and legal review, and consultation with senior management and key stakeholders, which could require 6 months. • Contracting companies record metrics related to downtime but may need time to incorporate new requirements into internal reporting processes • Several years may be required before comprehensive data can be collected and meaningfully analyzed. However, “pilot” initiatives to collect and analyze data should begin as soon as reasonably possible with the results being used to inform policy and regulation going forward

Ideal scenario	Current State	Recommendation	Intended Impact on Availability	Implementation
Theme 2: Enhancing preventative maintenance and outage management.				
<p>Preventative maintenance is performed on a regular basis and in compliance with all safety and availability regulations.</p>	<p>There are currently no minimum preventative maintenance standards, which appears to be undermining availability. Compliance with minimum maintenance standards <i>for safety</i>, shown to signal more effective preventative maintenance practices, is at an all-time low.</p>	<p>5. Assess options to enhance MCP effectiveness to ensure that devices are adequately and proactively maintained and that compliance is met, including restoring monthly maintenance for those devices with low availability or high risk, exploring the use of administrative monetary penalties (AMPs), or employing the full set of enforcement tools currently available to the TSSA including license revocation for contractors. For all options, seek to modernize regulations to better reflect the appropriate responsibilities of all stakeholders without losing the collaboration needed</p> <p>6. Provide education and awareness services for owners on effective preventative maintenance, “end of device lifecycle” and</p>	<p>5. Enhanced MCP effectiveness may lead to better maintenance practices overall, minimizing break downs and associated downtime</p> <p>6. Enhanced owner awareness on asset management practices will incentivize preventative maintenance, identified by stakeholders and through data analysis as one of the most significant drivers of non-availability</p>	<p>Short-term (3 – 6 months)</p> <ul style="list-style-type: none"> • MCP review is ongoing; final recommendations should be seen within 6 months • Implementation of recommendations may require regulatory amendment. This process can take 1-2 years • Education and awareness services exist and may leveraged

Ideal scenario	Current State	Recommendation	Intended Impact on Availability	Implementation
		other capital planning, and related topics		
<p>Repairs are conducted as quickly and efficiently as possible given the nature of the issue while balancing user and owner interests. Severe repair delays (over 48 hours) are reported to the accountable regulator and monitored.</p>	<p>Some buildings are left with partial or no elevator service for long periods. Reasons for prolonged outages are often complex and can include lack of parts availability, lack of mechanic availability, or delays in authorizing repair.</p>	<p>7. Require contractors to report outages over 48 hours or when 50% of the elevators are out of service, with a defined action plan to restore service. The action plan should include clearly defined owner / contractor responsibilities. Note that this replaces the 7/14 day repair timeline recommendation from <i>Bill 109</i></p>	<p>7. Reporting requirements will allow the responsible authority to better understand the circumstances surrounding these outages and may better target policy and regulation as appropriate</p>	<p>Long-term (1 – 3 years)</p> <ul style="list-style-type: none"> • Represents a significant shift in reporting requirements and will require the development of new processes • Further assessment of the responsible authority’s capacity to monitor action plans as well as the appropriate consequences for non-compliance is required prior to full implementation • Further assessment is required to determine whether reporting is on a regular schedule (e.g., provided annually) or at the request of the reporting authority as well as whether plans are evaluated on completeness or content
<p>Entrapments are rare and resolved quickly through rapid response from appropriate parties who ensure that passengers can safely exit the elevator car.</p>	<p>According to the National Elevator and Escalator Association, contractors documented approximately 9,649 entrapments across residential and institutional buildings in Ontario or about</p>	<p>8. Establish a consistent protocol for communication and accountability in case of entrapments, including emergency notification and communication between the owner,</p>	<p>8. Resolving entrapments with efficacy will put an out of service elevator back in service while also avoiding a potentially severe health and safety issue for passengers trapped in the elevator</p>	<p>Short-term (3-6 months)</p> <ul style="list-style-type: none"> • While industry uptake should be monitored over the long-term, new processes may build on existing practices • Implementation may include publishing educational material to

Ideal scenario	Current State	Recommendation	Intended Impact on Availability	Implementation
	<p>26 per day in 2016.¹⁷ Ontario firefighters responded to 4,467 calls for entrapments across all building types, or about 12 per day, in 2015, representing 1% of all calls responded to by Ontario fire services.¹⁸ While entrapments are rare, there is a lack of clarity around communication and accountability between owners, firefighters, and elevator contractors in circumstances involving entrapment, contributing to the discrepancy in contractor and firefighter data.</p>	<p>contractor, and first responders</p>		<p>both owners and users on best means of minimizing entrapments and dealing with them when they do occur</p>
<p>As a source of elevator industry knowledge and expertise, TSSA promotes and undertakes activities including data collection, registration, training, inspections, and enforcement to enhance public safety.</p>	<p>Despite a solid reputation for ensuring safety, industry parties expressed concern regarding consistency of regulations and effective communication with the industry.</p> <p>Industry believes that they have channels for input but have not been adequately engaged in strategic</p>	<p>9. Review options to enhance the efficacy of the Elevating Devices Advisory Council in providing a forum for industry consultation, input and advice</p> <p>10. Develop an annual industry satisfaction survey to help identify opportunities for greater communication and</p>	<p>9. Positive industry-regulator relations will foster collaboration and create channels through which industry can identify barriers to availability</p> <p>10. Continued evolution in the way the regulator and industry communicate will improve coordination on</p>	<p>Short-term (3-6 months)</p> <ul style="list-style-type: none"> The review and survey design processes should include meaningful consultation with industry. It should not take more than six months to initiate these processes and make substantial progress Further analysis may reveal other

¹⁷ National Elevator and Escalator Association. (September 2017). Reliable Elevators – How Ontario Can Become a National Leader for Transportation Systems in Buildings.

¹⁸ Data from Office of the Fire Marshal and Emergency Management, coded as “person trapped in elevator”.

Ideal scenario	Current State	Recommendation	Intended Impact on Availability	Implementation
<p>Acting as a “Modern Regulator” and incorporating broad and frequent industry and other stakeholder input into its decision-making, TSSA collaborates with industry on key technical and strategic matters affecting the industry.</p> <p>As in any relationship between industry stakeholders and a regulator, mutual trust is an important component.</p>	<p>decision-making on technical issues. They see this as a lost opportunity for the TSSA.</p> <p>The TSSA expressed strong views that accountability for availability cannot reside within their current mandate, which is focused on safety. Linkage of these two concepts, they argue, could impede current processes and lead to a weakening of Ontario’s strong record for safety.</p>	<p>collaboration with industry</p>	<p>issues related to availability</p>	<p>opportunities to better engage with industry</p>

Theme 3: Developing improved education and awareness for elevator owners on key availability topics.

<p>Market-based competition is driven by user choice, with active and informed users putting pressure on contractors to improve services. Contracts facilitate a “fair” marketplace: while minimum service standards are in line with owner expectations, there is an opportunity for higher value “premium” services for</p>	<p>Some owners may lack the technical knowledge and expertise to negotiate balanced contracts or advocate for improved service. Some owners report service standards not meeting minimum expectations while some stakeholders report that price competition has resulted in significantly curtailed maintenance services.</p>	<p>11. Develop education and awareness services for owners on topics including contract terms, elevator regulation, consultant services, etc., delivered through a combination of government, broader public sector organizations, building associations, or college courses</p> <p>12. Explore opportunities for greater disclosure of information to existing</p>	<p>11. Education and awareness on contract terms, regulation, and resources will enhance owners’ ability to advocate for service that will improve availability</p> <p>12. Clear communication will help set tenant expectations for availability, allowing for accommodation where availability is reasonably reduced and providing</p>	<p>Short- to medium-term (3-12 months)</p> <ul style="list-style-type: none"> Greater promotion of existing educational offerings (e.g., webinars and online training from Federation of Rental Housing Provider, BOMA, and others) might be used as a foundation Options for disclosure from the City of Toronto can be assessed immediately, with
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Ideal scenario	Current State	Recommendation	Intended Impact on Availability	Implementation
<p>those willing to pay more.</p>		<p>and potential building users about elevator maintenance / disruption, status of repairs, etc.</p> <p>13. Establish a public database of elevator uptime by address, with data voluntarily disclosed by contractors</p>	<p>transparency where availability issues exist</p> <p>13. Public disclosure of availability will help set expectations for the broader public on the state of availability, highlighting areas of strength and areas where issues exist</p>	<p>implementation timelines to be determined</p> <ul style="list-style-type: none"> Establishing a public database will require time for identification of an “owner”, set-up, and data collection; the government might work with existing models (e.g., RentLogic.com) to expedite roll-out
<p>Building owners include adequate maintenance and modernization in long-term capital and other financial planning.</p>	<p>Building owners may defer modernization or engage in less comprehensive maintenance service packages due to cost. Owners are often unaware of or unprepared for the cost of maintenance or replacement over a device’s lifecycle.</p>	<p>14. Encourage proactive “end of life” policies that build parts, maintenance needs, and cost of modernization into capital planning through targeted education, training, and resources</p>	<p>14. Effective capital planning is intended to ensure elevators are maintained and modernized as needed without cost acting as a barrier</p>	<p>Short-term (3-6 months)</p> <ul style="list-style-type: none"> Existing legislation, best practices, and consultant offerings might be leveraged to expedite implementation

Theme 4: Developing guidelines for the capacity of elevators required in new buildings.

<p>All new buildings are equipped with elevator capacity sufficient to transport the current and anticipated building population in a timely manner at high peak time.</p> <p>The sufficient number of elevators is determined following a standard, transparent, and repeatable process.</p>	<p>There are no regulated standards for the number of elevators required in a residential or institutional building. While some builders use third party elevator consultants for advice on the number of elevators required for a building, methodologies may vary. This means that results are not standardized and do not necessarily assure the same level of service.</p>	<p>15. Work with a recognized standards organization (e.g., CSA Group, UL Canada) and qualified persons to develop an industry standard that new residential buildings above a certain height and / or number of units contain a minimum number of elevators. The standard would be referenced in Ontario's Building Code</p> <p>16. Work with a recognized standards organization (e.g., CSA Group, UL Canada) and qualified persons to develop an industry standard for conducting elevator traffic analyses, to be referenced in Ontario's Building Code</p>	<p>15. Minimum standards will ensure buildings of a certain height or population size have at least some availability in case one device breaks down</p> <p>16. A standard approach to traffic analyses will ensure appropriate elevator capacity at the time of construction and, as a result, availability. Elevator traffic analyses could be required for certain building types with high occupant loads and would further refine requirements determined by the standard referred to in the previous recommendation</p>	<p>Long-term (1-3 years)</p> <ul style="list-style-type: none"> Engaging a standards development committee, conducting broader consultations, and developing and reviewing new standards could take up to 3 years to complete
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Ideal scenario	Current State	Recommendation	Intended Impact on Availability	Implementation
Theme 5: Reviewing regulations and industry practices to enhance labour mobility and availability.				
<p>There is a sufficient supply of highly skilled and qualified mechanics available to provide services as required. A clear pathway to support apprenticeship completions and certification is in place.</p>	<p>The number of Class A elevating device mechanics has not kept pace with growth in the number of elevating devices and elevating device trainees. Multiple stakeholders report a lack of qualified mechanics employed and able to respond efficiently to calls for service.</p>	<p>17. Amend the TSS Act regulations to include a “sunset clause” for EDM-T certification, requiring EDM-T’s to pursue further training within a given time frame</p>	<p>17. Maintaining an adequate number of qualified mechanics is intended to ensure outages are addressed as efficiently as possible</p>	<p>Medium-term (6 – 12 months)</p> <ul style="list-style-type: none"> • Issue has been identified by the TSSA and work is underway • Would require regulatory amendment
Theme 6: Providing reliable elevator access for first responders.				
<p>In cases of emergency, first responders are able to access the person in distress as quickly as possible.</p>	<p>Currently, all emergency personnel have access to a universal service key located in the building or provided by the on-site building supervisor. Some fire services equip frontline vehicles with their own universal key. Other fire services and first responders such as paramedics must retrieve the key from the onsite building manager or building owner, potentially resulting in delays to emergency response time.</p>	<p>18. Revise the Ontario Fire Code to require owners to notify the fire department, occupants and supervisory staff when a firefighter elevator is not operating for more than 24 hours</p> <p>19. Train all first responders to use a universal key in emergency situations</p>	<p>18. Reporting requirements will allow firefighters to be better prepared in emergency situations while also generating valuable data on non-availability and minimizing the amount of time an elevator is out of service</p> <p>19. The equal ability of first responders to reach an emergency will reduce the time required to respond to health and safety incidents, as well as the time required to return an elevator to service</p>	<p>Medium- to long-term (3 months – 2 years)</p> <ul style="list-style-type: none"> • Would require regulatory amendment, involving robust consultation with impacted stakeholders • Reporting protocol needs to be established • Further assessment is needed on the capacity of fire services to communicate reported outages to the “Availability” authority • Process needs to be established to provide training to all first responders on correct universal key use

Scope and Approach

Purpose and scope

There are almost 20,000 passenger elevators across more than 10,000 residential and institutional buildings in Ontario.¹⁹ As the existing stock of elevators ages and the province experiences a rapid growth in construction of buildings (including high-rise condominiums), elevator availability is under increasing scrutiny. Over the past few years, stakeholders across Ontario have raised a variety of issues related to elevator availability, including:

- Public and worker safety
- Accessibility for users, access to homes, and access for emergency responders
- Cost and speed of maintenance
- Slow repair times and long elevator outages
- Owner and user knowledge of elevators as a key asset
- Entrapments and emergency response processes
- Labour supply of elevator mechanics
- Fair and open markets for contractors
- Impact of regulation of the elevator industry

The topic of elevator availability has been covered in a variety of mainstream media in recent months, and has garnered political attention.²⁰ MPP Han Dong tabled a private member's bill, *Bill 109, Reliable Elevators Act, 2017*, in the Ontario legislature in March 2017, which has now passed second reading and been referred to the Standing Committee on Regulations and Private Bills. The bill (in its present form) will require a person who applies for a permit to construct a building with seven or more storeys to show that the building will have enough elevator capacity. It will also require an elevator that breaks down to be repaired within 14 days for most buildings and seven days for long-term care homes and retirement homes. Finally, the bill calls for more robust and widespread elevator usage studies. The MPP acknowledges that much of the input he received was anecdotal or based on perception and is open to a more robust, evidence-based set of recommendations relative to this topic.

To respond to emerging concerns associated with elevator availability, the Technical Standards and Safety Authority (TSSA), in partnership with the Ministry of Government and Consumer Services (MGCS) and the Ministry of Municipal Affairs (MMA), have engaged me to author an independent study, with support from Deloitte's Public Sector Strategy team.

The purpose of this study is to define and assess the state of elevator availability in Ontario, identify key drivers of issues with availability, and propose a series of solutions (both regulatory and non-regulatory) to inform policy discussions.

A Brief Overview of the Sector and its Stakeholders

For those assessing availability in the sector, a number of key stakeholders should be known and their interests understood. While a detailed overview exists in the report, these stakeholders include:

¹⁹ TSSA data. Examples of residential buildings include condominiums, rental housing, or student residences, while institutional buildings include retirement homes, long-term care homes, and other group homes. This study has focused on institutional buildings with long-term residents. Hospitals and other short-term health facilities fall outside the scope of the study.

²⁰ As noted in the Executive Summary, the proposed definition of "Availability" is discussed in detail in Section 2. Where the term "Availability" is not explicitly defined in this report, it refers to the general understanding of availability as the reliable functioning and timeliness of an elevator.

- **Elevator Users:** Users of the 19,900 residential and institutional elevators in Ontario take over 655,000 elevator trips a day.²¹ These users include tenants of rental buildings, condominium owners, or people using a hospital, assembly, school, or other public facility. They also include seniors, persons with mobility issues, and residents completing daily tasks.
- **Elevator Owners:** Every device in Ontario has a licensed owner. The license holder could be the building owner – the rental property owner, the condominium corporation – or the building owner's representative - the property management company representative or building manager. The owner is responsible for the safe operation and maintenance of the elevator as well as any reporting on its status.
- **Elevator Manufacturers:** Elevator manufacturers build elevators and construct elevator parts. They create proprietary technology to continue improving the safety and efficiency of elevators. Four large manufacturers serve the majority of the Ontario market: Kone, Otis, Schindler, and ThyssenKrupp.
- **Elevator Contractors:** Elevator contractors employ 3,500 mechanics in Ontario to maintain and repair elevators.²² Elevator contractors are registered with the TSSA and report on the installation number, class, location, and scope of maintenance for each device under their authority. The TSSA also administers testing and certifies elevating device mechanics.
- **Elevator Consultants:** Elevator consultants have emerged in Ontario over the past 20 years as a response to the increasing need for elevating devices in high-rise buildings. Consultants specialize in the design and scoping of elevators. They may advise developers and architects on product selection or help owners of existing buildings to understand service and maintenance needs.
- **Building Industry:** This group includes the architects, developers, engineers, municipal chief building officials, and building inspectors who are involved in the design and regulatory oversight of the construction and / or renovation of a building.
- **Technical Standards and Safety Authority (TSSA):** TSSA is a statutory corporation with delegated authority to administer and enforce public safety laws and regulations in the four designated sectors under the province's *Technical Standards and Safety Act, 2000* and associated regulations, including those applying to elevating and amusement devices. The TSSA works to investigate incidents and enforce safety while also focusing on prevention through informing and educating end-users and industry regarding safety requirements. As a statutory corporation, the TSSA delivers activities through a "fee for service" cost recovery model.²³
- **Ministry of Government and Consumer Services:** In addition to other responsibilities, the Ministry of Government and Consumer Services oversees the TSSA and has a mandate to strengthen consumer protection and public safety for Ontarians.
- **Ministry of Municipal Affairs:** Among other responsibilities, the Ministry of Municipal Affairs administers the Ontario Building Code. The Code provides guidance and detailed technical and administrative requirements as well as minimum standards for building construction, including for elevators. The Code is forward-looking and does not apply retroactively.
- **First Responders:** First responders, including firefighters, paramedics, and police, are responsible for addressing emergencies in a timely and efficient manner. Lack of elevator access can be a significant barrier to their ability to quickly respond to and address an emergency, potentially introducing health and safety risks for residents.

These stakeholders operate in the context of a rapidly growing industry that has seen significant evolution over the past 30 years (see Figure 1).

²¹ Calculated based on National Elevator Industry, Inc. estimates for passenger trips per day in the United States (12 billion) and adjusted for number of passenger elevators in residential and institutional buildings in Ontario (approximately 19,900).

²² TSSA data.

²³ The TSSA sets fees on a cost recovery basis for registration, inspection, engineering, examination, and permit and licensing.

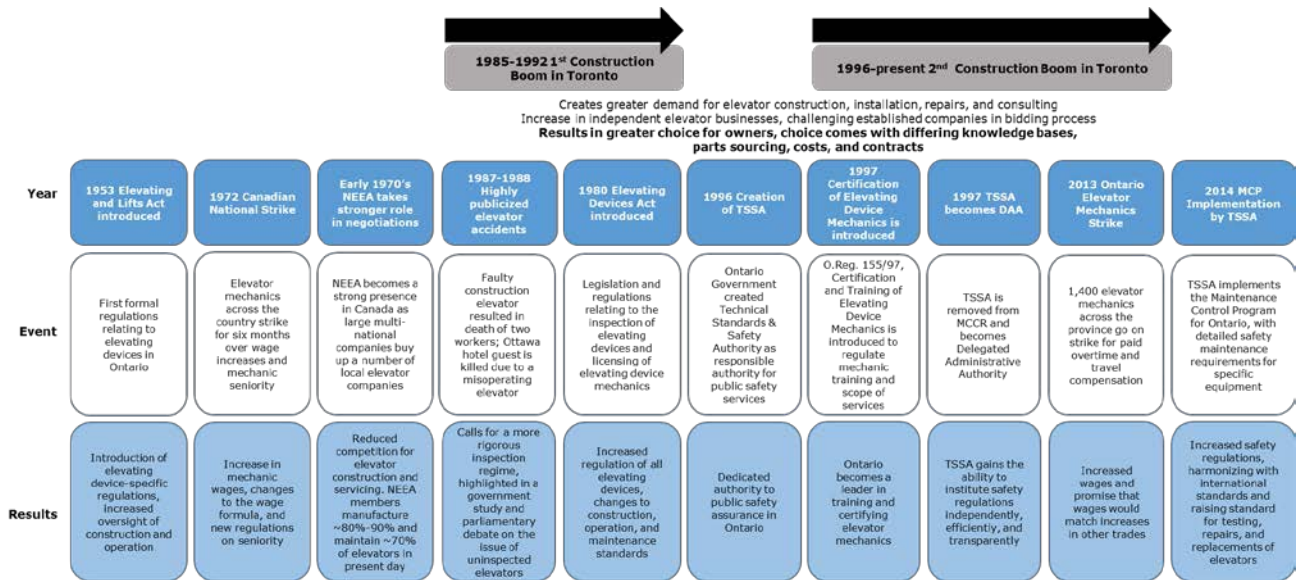


Figure 1 - Evolution of the elevator and building industry, 1972 - Present²⁴

These events have led to a highly regulated industry. Labour supply is strongly unionized and highly responsive to fluctuations in construction activity. Finally, while a small group of companies provide close to 75% of maintenance services, the market is opening up as independent contractors and consultants become more prevalent.²⁵

Approach and methodologies

Elevator Availability Framework

We developed the “Elevator Availability Framework” (see Figure 2) as a tool to structure research, test hypotheses, and conduct stakeholder interviews. We heard very clearly from stakeholders that recommendations need to drive five core outcomes:

- Maintaining and enhancing public safety to build upon Ontario’s strong track record
- Creating a barrier-free Ontario through greater elevator availability, ensuring access for users, access to homes, and access for emergency responders
- Enhancing user satisfaction with elevator service and public confidence in the regulatory and market system
- Supporting housing affordability and suitability through smart regulation and a balanced, effective marketplace
- Promoting business enablement by introducing regulations where needed and where the benefit outweighs the cost

²⁴ The timeline represents a sample of highlighted key events, selected in consultation with elevator industry subject matter experts.

²⁵ Estimate by industry stakeholders and based on TSSA data.

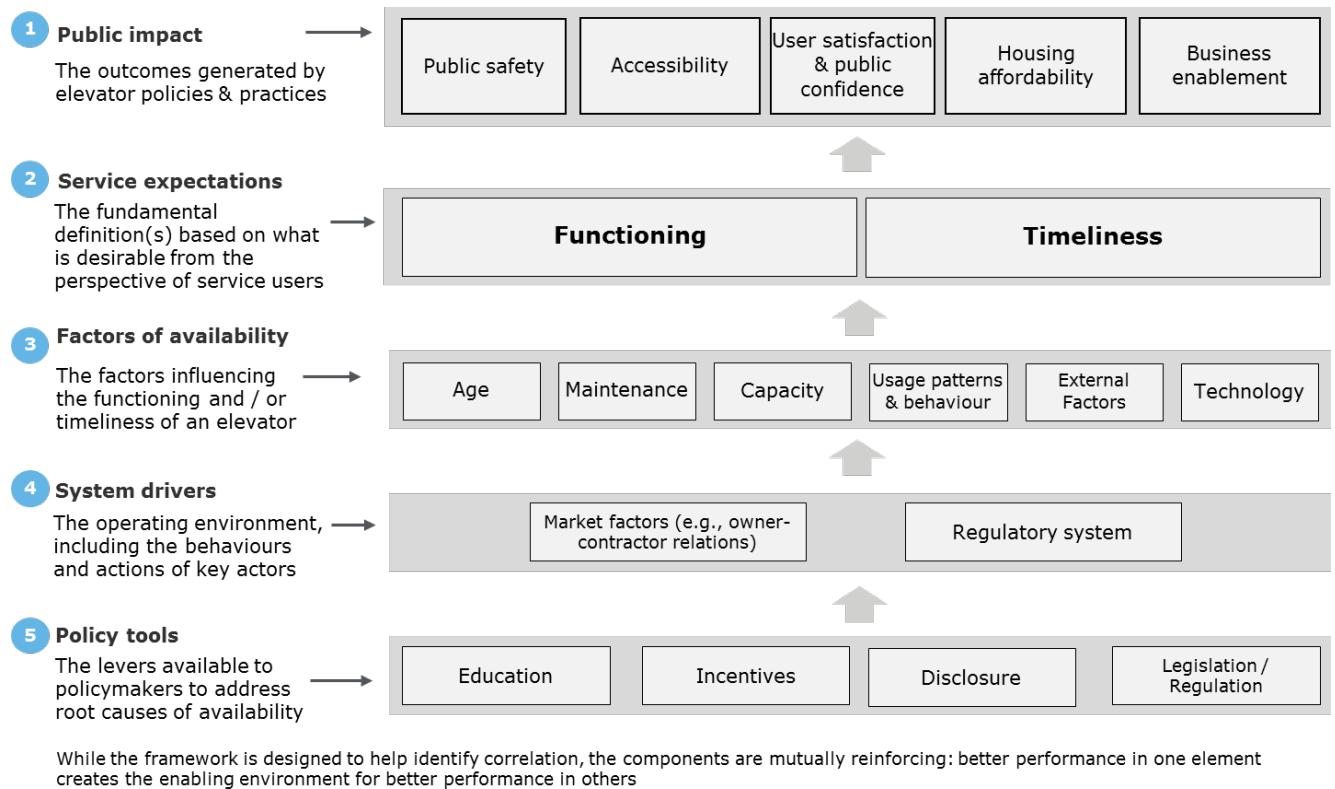


Figure 2 - Elevator Availability Framework

Jurisdictional and media review

We looked at how public, private, and academic organizations in other jurisdictions approach elevator availability through desk research and interviews with industry stakeholders. Research focused on six municipal or regional jurisdictions with rapid or comparable growth in high-rise density to Ontario as a whole as well as international standards organizations, transit authorities, Canadian municipalities, state-level regulatory bodies, and private sector groups addressing the topic of elevator availability.²⁶

Overall, other jurisdictions recognize the importance of timely and operational elevators. Although there are various global initiatives underway to study availability at the international, national, and sub-national level, there is comparatively **limited public policy and regulation in place governing elevator availability across jurisdictions.**

Most notably, there is **no proactively enforced regulatory definition for “Availability” in place.** International standards-setting bodies, transit authorities, private sector actors, and open data platforms define availability based on the amount of total time a device is operational or its technical reliability. Market-based mechanisms, such as the contract between elevator owners and contractors, are typically used to drive elevator service standards. A range of municipal property standards in Ontario require elevators be kept operational and in good repair, although it is within the discretion of inspectors to determine whether the standard has been met.

Research was conducted through desk-based analysis of elevator regulatory organizations’ websites and databases (with mandatory disclosure requirements and voluntary disclosure), review of publicly available research reports and documents (e.g., building codes, annual reports, strategic plans, etc.), and select stakeholder interviews to gain perspectives on the jurisdictions in focus.

²⁶ The six core jurisdictions covered were Chicago, Hong Kong, London, New York City, Singapore, and Vancouver.

Five research questions informed jurisdictional research and data collection, with a summary of findings included below and incorporated as appropriate throughout the report:

Core Mandate of Elevator Regulatory Bodies

The focus of the current legislation across jurisdictions is on user safety or accessibility, rather than availability.

Non-safety-related elevator service issues are typically addressed through market-based mechanisms, such as the contract between elevator owners and elevator contractors. While there are a range of regulatory maintenance standards that require elevators be kept operational and in good repair, it is up to the discretion of inspectors to determine whether the standard has been breached.

The Ontario government would be the first jurisdiction in the world to establish regulatory requirements for measurable, non-safety related elevator service issues (for instance, minimum repair times as a measure of consumer protection).

Definition of Elevator Availability

Elevator regulatory authorities across the six core jurisdictions examined do not define or regulate availability.

International standards-setting bodies, transit authorities, private sector actors, and open data platforms define availability in various ways that might guide Ontario in setting reasonable availability service standards. For example, the International Electrotechnical Commission defines availability for electrotechnology more broadly as, "The combined characteristics of the reliability, recoverability, and maintainability of the item, and the maintenance support performance".²⁷ Transport for London defines availability as, "The total hours elevators are working as a percentage of total scheduled service hours".²⁸

Factors and System Drivers of Availability

A diverse and complex set of interrelated technical issues drive availability across jurisdictions, including age, maintenance, capacity, usage patterns and behaviour, external factors, and technology.

Public policy across surveyed jurisdictions focuses on regulating market factors and regulatory systems, as they influence availability. The owner-contractor relationship appears to be the primary market factor influencing availability as information asymmetry and rigid contract terms can limit consumer choice. For example, there have been cases in the European Union, Israel and Japan addressing anti-competitive practices among elevator contracts. These issues have generally been found to be systemic rather than relating to any one specific company.

Insufficient labour capacity across the supply chain may be also be a barrier to timely and quality maintenance and repair. Initiatives underway in Singapore and New York are seeking to improve training and qualifications for architects, builders, and mechanics.

Finally, many jurisdictions, most notably Singapore and Chicago, are focused on gathering and aggregating data on the condition, repair process, and reliability of elevating devices as a tool for monitoring and regulatory enforcement.

²⁷ Electropedia: The World's Online Electrotechnical Vocabulary. (<http://www.electropedia.org>)

²⁸ Transport for London. "Lift Availability" (<https://tfl.gov.uk/corporate/publications-and-reports/lift-availability>)

Policy Tools

A variety of municipal jurisdictions, including New York, Chicago, and Singapore, have recently implemented or proposed legislation relating to elevators. In Ontario, several municipalities have included elevator availability as a component of the Property Standards By-law, setting standards for maintenance and operability.

New York City has proposed stricter licensing requirements for elevator mechanics to improve elevator safety and reduce the number of breakdowns. The City of Chicago has expanded its Annual Inspection Certification program to ensure that building owners take responsibility for maintaining their equipment as safe and operational and that they report the state of the elevator and inspection status to the Department of Buildings. The Building and Construction Authority in Singapore recently introduced a series of measures to enhance lift reliability and safety, including a new “Permit to Operate” (PTO) system, changes to incident reporting requirements, stricter enforcement, stronger penalties on lift contractors for breaches of maintenance regulations, and efforts to strengthen industry capacity throughout the supply chain. While these changes are too recent to be able to monitor results, they signal a shift in the industry towards greater transparency and reporting regarding elevators as an essential service.

Finally, several municipalities across Ontario have Property Standards By-law requirements for elevators to be maintained in operating condition. There are no specific corresponding measures to enable monitoring or proactive enforcement of these requirements.

Regulatory Trends

Recent regulatory trends include risk-based assessment, outcome-based regulation, self-reporting / self-assurance, cost recovery, collaborative regulation, and data and information sharing. These approaches have been applied across sectors and regions, and focus on “right-touch” regulation, balancing risk of harm and regulatory burden, and shared ownership for regulatory activities. Stakeholders noted that Quebec takes a relatively light approach to regulating elevator safety, resulting in safety outcomes similar to Ontario.²⁹ When considering how to apply regulatory innovations to Ontario, achieving the right balance of regulation will mean adapting these experiences to reflect the unique industry and regional context.

A summary of findings for the six core jurisdictions is included in Appendix B.

License holder survey and secondary data analysis

There is currently no comprehensive and publicly available data concerning “Elevator Availability” in Ontario. In order to build a fact base and start to assess the current state, we distributed a survey directly to 2,942 institutional and residential passenger elevator license holders across Ontario as well as through communications from the Association of Condominium Managers and Owners, the

²⁹ Elevator safety in Quebec is regulated by the Régie du bâtiment du Québec. The Régie oversees the Building Act, which provides for the adoption of a Construction Code and a Safety Code. The Construction Code applies to plan and specifications designers and contractors, while the Safety Code applies to owners of buildings and facilities. Chapter IV of the Construction Code (in force since 2004) and Chapter IV of the Safety Code (in force since 2006) outline requirements for the construction and maintenance of elevators and elevating devices. References in the Construction Code are taken directly from the Safety Code for Elevators and Escalators, ASME A17.1-2007/CSA B44-07 and other relevant CSA standards, harmonized across North America and also used as a basis for TSSA regulation. The Construction Code sets requirements for builders and contractors intending to build, or seeking to have a new construction approved. In Quebec, all persons undertaking construction (e.g., contractors) must be licensed. The Safety Code specifies that elevators should be maintained in safe and proper operating condition according to CSA B44-07 requirements and that appropriate rectification should be taken if “hazardous operating conditions have developed due to, in particular, intensive use, wear and tear, obsolescence or alterations”. Owners are charged fees for inspection and may be issued a remedial notice with time to comply for non-compliance with regulations. <http://legisquebec.gouv.qc.ca/en/ShowDoc/cr/B-1.1,%20r.%203>

Federation of Rental Housing Providers, and the Ontario Non-Profit Association. The survey totalled 15 questions, and took respondents on average 20 minutes to complete. 250 license holders responded, providing a useful fact base to start to assess elevator availability across Ontario.

Survey results achieved a confidence level of 95% with an interval of 0.06.³⁰ The survey data does contain limitations that should be considered. Not all respondents submitted responses to all questions, depending on relevance to their building or level of estimation required (e.g., number of passengers using an elevator during one hour at high peak time). Responses with the majority of questions answered were used for analysis. All survey data is reported by owners, with varying levels of technical expertise or device knowledge, and relies for some data points on estimates (e.g., average waiting time in seconds). Accordingly, the resulting analysis should be considered in this context.

Survey results were cross-referenced with key sources of external data, including:

- TSSA data on compliance rates, safety incidents, age of elevators, and certified mechanics
- Aggregated data from contractors about entrapments and device downtime
- Municipal data concerning elevator-related complaints
- Long-term care home inspection data, including inspection outcomes and causes for elevator outage from 2015 to present
- Sample comprehensive and inspection maintenance contracts, representing a range of small and large building owners, independent and multinational elevator contractors, and elevator consultants

We also reviewed international standards, existing provincial legislation and regulation, municipal by-laws and policy, and industry practice to inform recommendations. The *International Electrotechnical Commission* standards for dependability and related terms, the *Chartered Institution of Building Services Engineers (CIBSE) Guide D*, and the pending *ISO/WD 8100-32: Planning and selection of passenger lifts to be installed in office, hotel and residential buildings* were used to inform the technical aspects of defining and measuring availability. Provincial and municipal legislation, regulation, and policy informed my understanding of the context for elevator availability and the various remedies available.³¹

Risk assessment

A risk assessment was performed in order to characterize the issue of availability in terms of its impact on public safety. The assessment estimated the risk of injury or fatality due to non-availability, including the significance and the causal factors of that risk.

Estimates relied upon TSSA data, input from an experienced contractor, TSSA inspector, and risk analyst and data from other sources (including data from the Office of the Fire Marshal and Emergency Management and contractor data). The assessment found the risk of injury or fatality due to non-availability to be well below acceptable risk thresholds.

The findings rely heavily on expert input and recommends further data collection to validate and to continue monitoring the findings. Key findings are included in this study and are considered as one of various other inputs in the decision-making process. Please see Appendix D for detailed methodology and approach.

³⁰ Generally a confidence level of 0.05 would be considered statistically significant.

³¹ Provincial legislation and regulation included (but was not limited to) the Ontario Building Code, the Consumer Protection Act, the Residential Tenancies Act, the Accessibility for Ontarians with Disabilities Act and elevator safety legislation and regulation across jurisdictions (most notably the Technical Standards and Safety Act and related regulations). Municipal review looked primarily at Property Standards By-laws and Toronto's new Apartments By-Law and RentSafeTO program.

Stakeholder consultations

This report is the result of extensive stakeholder consultation and could not have been completed without the commitment of experts from across the elevator industry.

Over 50 individual interviews³² were conducted with:

- Building owners and managers (residential, institutional; private, non-profit; condominium, rental)
- Developers and builders
- Manufacturers / contractors (multi-national, independent, associated member associations)
- Architects
- Engineers
- Building officials
- Tenants' associations
- Consumers' associations
- First responders (fire services)
- Municipalities (licensing and standards, inspectors)
- Regulatory bodies
- Government ministries and agencies

In addition, over 30 interested parties and government representatives participated in two workshops, which focused on reviewing emerging findings and identifying solutions. Input from these sessions and the interviews helped refine regulatory and non-regulatory options to address key challenges, particularly where there was lack of clarity or consensus.

Detailed Report Structure

The body of the report is divided into six key sections corresponding to each core theme of the study and this is followed by key considerations for implementation. Within each section, I describe the "ideal scenario" as represented by stakeholders, a best effort depiction of the current state, and key recommendations with supporting rationale.

I have not included a direct comparison between my recommendations and the provisions in the *Bill 109, Reliable Elevators Act, 2017* but have referred to the Private Member's proposed solutions where relevant throughout the report. I believe the 19 recommendations reflect the spirit and intent of *Bill 109* as well as related initiatives including *Ontario's Fair Housing Plan*. It must be noted, however, that *Bill 109* is based for the most part on anecdotal evidence. This study is intended to present a more balanced view, based on wide ranging consultation on the potential impacts on affordability and feasibility resulting from the provisions in *Bill 109* and other suggested solutions. The report offers what I see as effective, efficient and pragmatic options to improve elevator availability.

Given the relatively short duration of the study and the paucity of existing data, assumptions and estimates are clearly communicated where relied upon, and notations of further required analysis are included in a variety of areas.

The report describes the challenges that the study sought to address as well as relevant background and contextual information. A glossary of terms and a detailed overview of our stakeholder consultations and research are included as appendices. I thank those organizations that made formal written submissions for consideration and which I have attempted to incorporate.

³² Please see Appendix C for a full list of organizations consulted.

I. Defining and measuring “Elevator Availability”

Ideal scenario

There is a consistent and clear definition of “Elevator Availability” with reporting in place that facilitates accurate and informed regulation and policymaking as well as clear communication to stakeholders.

The definition is precise yet practical and embodies the following characteristics:

- Clear and understandable to all stakeholders
- Facilitates accurate measurement and has clear boundaries
- Builds upon existing industry practices
- Supports regulatory policy development (e.g., to inform discussions on *Bill 109, Reliable Elevators Act, 2017*)

It captures what is desirable to users and people more broadly: the functioning and the timeliness of a device. In keeping with modern regulatory principles, the measurement used for availability is outcome-based and can be applied to different building types and devices.

An organization or coordinated network of organizations within the broad purview of the Government of Ontario have clear accountability for measuring and managing “Availability” across residential and institutional buildings in Ontario. This organization or network is a single source of knowledge for building owners and the public on matters relating to availability regulation, policy, education and awareness, and training programs. The organization or network is a global leader in evidence-based policy-making on the topic, leading data collection and analysis to consistently and transparently monitor the state of availability over time.

Current state

There is no commonly accepted definition of availability today. Globally, no elevator regulatory authority defines or regulates availability. The focus of the *Technical Standards and Safety Act, 2000*, the *Long-Term Care Homes Act, 2007*, and similar legislation and regulation in other jurisdictions, is on user safety and accessibility, rather than availability.

Public sector organizations (e.g., transit authorities), elevating device industry stakeholders (e.g., developers, consultants, engineers, contractors), and international design standards (e.g., architectural and engineering specifications) define availability in a number of ways, most often as total time operational (or uptime), time elapsed between incidents, or average time to repair.

For example, the International Electrotechnical Commission defines availability for all electric devices as, “The combined characteristics of the reliability, recoverability, and maintainability of the item, and the maintenance support performance”.³³ Transport for London defines availability as, “The total hours elevators are working as a percentage of total scheduled service hours”.³⁴

There are also a range of regulatory maintenance standards at the provincial and municipal level in Canada that require elevators be kept operational and in good repair. Municipalities including, but not limited to, the City of Burlington, Haldimand County, the City of Mississauga, the City of Niagara Falls, the City of Toronto, and the City of Vancouver have variations of this requirement in their Municipal

³³ Electropedia: The World’s Online Electrotechnical Vocabulary. (<http://www.electropedia.org>). For a detailed description of each of these terms see the Glossary of Terms in the appendix to this document

³⁴ Transport for London. “Lift Availability” (<https://tfl.gov.uk/corporate/publications-and-reports/lift-availability>)

Property Standards By-laws.³⁵ The City of London Property Standards By-law references good maintenance and requires elevating devices to be “repaired as expeditiously as possible” but does not specify a required timeline.³⁶

The City of Hamilton passed a similar by-law in March 2016 providing for capacity as well as operability, stating:

- a) Elevators shall be maintained in operation at all times except for such reasonable time as may be required for repair or replacement as follows:
 - i. one elevator, where one elevator is provided and there is no firefighters’ elevator;
 - ii. one elevator where two or more elevators are provided and there is a firefighters’ elevator;
 - iii. two elevators where two or more elevators are provided and there is no firefighters’ elevator³⁷

Different organizations may measure the same definition in different ways. For instance, some transit authorities consider a device out of service for scheduled maintenance to be “available” while others include all time out of service for any reason as “downtime” or time not operational.

Priority is on functioning rather than timely elevators

The primary focus of public concern appears to be on whether elevators are functioning. The majority of municipal complaints related to elevators refer to situations where a building was left partially or completely inaccessible (e.g., devices being out of service for a prolonged period of time or situations where a building has no elevator service whatsoever).³⁸ Timeliness is primarily a concern when an out of service elevator results in extremely long wait times for the remaining elevators.

Industry understanding of availability also focuses on operation. Contracting companies collect and monitor several key metrics including uptime, call out time efficiency, incidents per device, entrapments per device, etc. to measure performance and service quality.³⁹ “Acceptable” levels of timeliness are generally based on the level of convenience a building’s population expects. This can vary widely according to the population (e.g., condominium compared with long-term care home residents), building type and usage (e.g., mid-size rental building compared with high-end condominium; resident use compared with high visitor traffic), and location.

There is an acute absence of publicly available information on the current state of elevator availability despite the fact that private contracting companies collect data on elevator outages by tracking service calls.⁴⁰ Only transit authorities and some more sophisticated building owners track performance, as measured by total time devices are operating, by engaging external consultants to work with the contractor to get data.

³⁵ City of Burlington Property Standards By-law 28-2009; Corporation of Haldimand County By-law No. 730/06; City of Mississauga Property Standards By-law 654-98; City of Niagara Falls Property Standards By-law No. 2015-101

³⁶ City of London Property Standards By-law CP-16.

³⁷ City of Hamilton By-law No. 16-093.

³⁸ The number of elevator-related complaints received by the City of Toronto’s Municipal Licensing and Standards Division have slowly increased since 2011. Of 331 complaints received in 2017, 59% of complaints concerned non-operational or malfunctioning elevators, while 4% of complaints concerned elevators taking too long.

³⁹ See Glossary of Terms for definitions.

⁴⁰ Companies will track the time from when they are first called for repair or scheduled to arrive for maintenance to the time the elevator is put back in service. These hours spent on equipment constitute down time.

Contracting companies and transit authorities typically strive for a 98% time operational over a given year.⁴¹ Data from the National Elevator and Escalator Association suggests their membership, occupying close to 75% of the Ontario market, achieved over 99% last year.⁴²

Other data received, however, indicates **that there may be issues relative to elevator availability**. One out of five building owners surveyed reported availability of less than 95%, the equivalent of approximately 18 days or more out of service over the course of a year.⁴³ Most buildings with low availability were in the Greater Toronto Area, also the location with the most elevators in the province. Condominiums surveyed reported the lowest average availability by building type, at 93%. There was no correlation found between the reported date of installation or last alteration and the reported uptime of a device. Estimates based on TSSA data and expert analysis placed average availability in residential and institutional buildings across Ontario at 97%, or approximately 10 days, over the past year.⁴⁴

⁴¹ Availability is measured for a building's system of devices as opposed to an individual device. Transport for London. "Lift Availability" (<https://tfl.gov.uk/corporate/publications-and-reports/lift-availability>); input from the Toronto Transit Commission; National Elevator and Escalator Association. (September 2017). Reliable Elevators – How Ontario Can Become a National Leader for Transportation Systems in Buildings.

⁴² National Elevator and Escalator Association. (September 2017). Reliable Elevators – How Ontario Can Become a National Leader for Transportation Systems in Buildings.

⁴³ Deloitte license holder survey results

⁴⁴ Based on fault-tree analysis conducted on TSSA data and expert input from contractors, inspectors, and TSSA data analysts, estimated that elevators were operational 97% of the year.

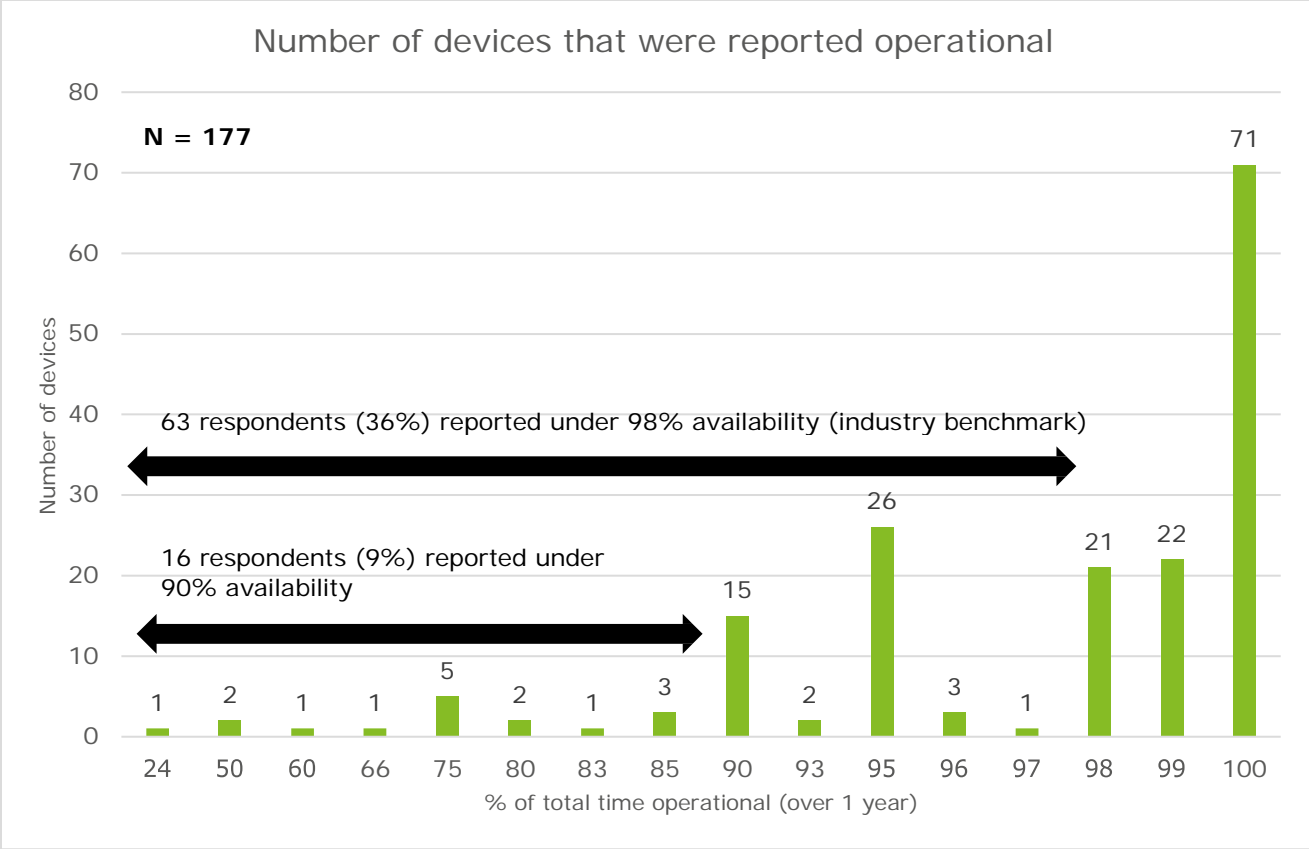


Figure 3 - Proportion of total time devices were reported operational⁴⁵

The estimates available demonstrate that availability is a clear issue for a portion of the population. We heard from stakeholders and saw, through our own analysis, that those cases of severe or ongoing non-availability are typically due to a complex combination of reasons.

Take the example of a seven-storey building with one elevator. That elevator is out of service for three weeks, resulting in extreme difficulty for a senior resident on the seventh floor. This outage could have a range of potential causes. Perhaps the owner could not pay for a comprehensive contract and the device is not receiving adequate regular maintenance. Perhaps the contractor is waiting for an obsolete part to be manufactured so the device can be modernized. Perhaps the elevator broke down due to long-term water damage. Most likely, it is a combination of many of these factors.

The first step in enhancing availability is a **definition and measurement process for availability**. Having considered a number of options based in international standards, industry practice and, most importantly, user expectations, I recommend defining availability as **“the ability of a building’s elevating devices to transport persons as and when required”**.

Distributed Accountability

No single organization currently has responsibility for managing availability across residential and institutional buildings. Accountability for related concepts, including the reliability, safety, operability, and accessibility of elevators, is distributed across the OPS, the broader public sector, and municipalities.

⁴⁵ Deloitte license holder survey results. As survey questions were voluntary, not all respondents answered all questions. As such, response numbers may not add to a total 250.

This is partly because no organization’s mandate specifically includes availability. The complexity of the topic means that a number of organizations, existing regulation, and market factors influence the drivers of availability and potential causes of non-availability. Take maintenance as an example. The TSSA would address a lack of elevator maintenance that results in safety concerns, while the Landlord and Tenant Board or a municipality might enforce a lack of maintenance that violates the Residential Tenancies Act or Property Standards By-laws (if such a by-law exists).

To illustrate this point, the table below provides an overview of the various parties involved in regulation, legislation, or policy development on topics related to elevator availability in Ontario. This includes elevator construction and installation, safety, maintenance, and market environment.

Organization	Responsibility for Elevators
<p>Technical Standards and Safety Authority (TSSA)</p>	<p>The TSSA administers the regulation of elevating devices in Ontario to ensure all devices conform to the Technical Standards and Safety Act, 2000 and applicable regulations, codes and standards. TSSA reviews and registers the design of new elevating devices, issues licenses for elevating devices, issues mechanic licenses, registers contractors, conducts inspections and performs incident investigations.</p> <p>The TSSA may use enforcement tools including license revocation, legal orders and prosecution as appropriate in cases of non-compliance.</p>
<p>Ministry of Municipal Affairs (MMA)</p>	<p>MMA administers the Building Code Act and Ontario’s Building Code, which contains requirements for elevators in certain buildings and for clearly defined purposes, including:</p> <ul style="list-style-type: none"> • At least one firefighter elevator is required in residential buildings more than 18 metres in height • At least one elevator is required in care and treatment facilities providing services above the ground floor level • Elevators may be needed to effectively satisfy barrier-free path of travel requirements in large buildings <p>The Building Code also references industry recognized design and safety standards to which elevators are required to conform when installed in new buildings and speaks to accessibility requirements in new buildings.</p> <p>The Ontario Building Code applies only to new construction or major renovation (including change of use).</p> <p><i>Bill 109</i> proposes amendments to the Building Code to mandate elevator traffic analyses for all new builds.</p>
<p>Municipalities</p>	<p>Municipalities may have a number of responsibilities related to monitoring and enforcing the operability of elevators.</p> <p>Municipalities are responsible for enforcing the Building Code within their jurisdictions, including:</p> <ul style="list-style-type: none"> • Reviewing building permit applications and issuing permits • Conducting inspections during construction to ensure work is in compliance with the Building Code and building permits • Setting fees for building permits • Enforcing compliance through inspections and if necessary, issuing orders (e.g., stop work orders and orders to comply)

Organization	Responsibility for Elevators
	<p>Chief building officials and qualified inspectors carry out Building Code enforcement. Municipalities may prosecute individuals, including building owners, for failure to comply.</p> <p>Municipalities may also develop property standards by-laws that address how buildings and surrounding area should be maintained. Currently, 60% of municipalities in Ontario have residential property standards by-laws that cover the interior and exterior of buildings across the entire geographic area.⁴⁶</p> <p>By-law enforcement officers may have a number of tools at their disposal to enforce by-laws, including fines, orders to comply, remedial action and prosecution.</p> <p>Some property standards by-laws include requirements that elevators, where installed, be kept in good, operable condition. While orders have been issued in some larger municipalities for non-functioning elevators, the municipality typically ends up taking remedial action itself, as the enforcement process can be costly and time consuming.</p>
Ministry of Government and Consumer Services (MGCS)	MGCS oversees eleven administrative authorities, including the TSSA, responsible for ensuring that Ontario's consumer protection and public safety laws are applied and enforced. The he Ministry also governs the <i>Consumer Protection Act, 2002</i> , which protects consumers against unfair business practices, including contracts.
Ministry of Housing (MHO)	<p>MHO is responsible for a range of legislation related to housing fairness, landlord-tenant relations, and property maintenance, including the <i>Residential Tenancies Act, 2006</i> and related regulations. Ontario's Fair Housing Plan (2017) specifically included a proposal to enhance elevator reliability by establishing timelines for elevator repair in consultation with the sector and the TSSA. The legislation currently under the purview of the Ministry of Housing only applies to rental housing (and would not affect other multi-storey buildings).</p> <p>The <i>Residential Tenancies Act, 2006</i> outlines landlords' maintenance / repair responsibilities, which may be enforced through the Landlord and Tenant Board (LTB) in cases of non-compliance. Enforcement is only pursued in extreme cases due to the heavy burden of proof, cost, and time required. Previous rulings have awarded damages due to tenants for prolonged elevators outage.⁴⁷</p> <p>As well, recent amendments to the <i>Residential Tenancies Act, 2006</i> require the LTB to delay or deny an above-guideline rent increase if there are any outstanding elevator-related work orders (from either TSSA or the relevant municipality). This is anticipated to come into effect in 2018.</p>
Other provincial ministries or groups (e.g., Ministry of Health and Long-Term Care, Accessibility Directorate, the Office of	A number of other provincial ministries oversee legislation, regulation and / or policy related to elevator availability, typically focused on specific buildings or circumstances. A sample of most relevant ministries are summarized here.

⁴⁶ Based on publicly available data from the Ministry of Municipal Affairs, 266 municipalities out of a total 444 have complete property standards by-laws (meaning the By-law covers the interior and exterior of buildings) (<https://www.ontario.ca/data/municipal-property-standards-bylaws>).

⁴⁷ Landlord and Tenant Board Ruling under Section 30, Residential Tenancies Act, 2006, regarding 406, 270 Sheldon Avenue; Onyskiw v. CJM Property Management Ltd., 2016 ONCA 477 (20160616, Docket C61131)

Organization	Responsibility for Elevators
the Fire Marshal and Emergency Management, Ministry of Seniors Affairs)	<p>The Accessibility Directorate of Ontario oversees legislation and standards focused on removing (and preventing) barriers for persons with disabilities to participating in all aspects of everyday life. Under the Integrated Accessibility Standards Regulation, Customer Service Standards, organizations are required to provide notice to the public of a temporary disruption of services that could apply to out of service elevators.</p> <p>The Office of the Fire Marshal and Emergency Management sets and enforces standards related to firefighter elevators and access to buildings in cases of emergency through the <i>Fire Protection and Prevention Act, 1997</i> and the <i>Ontario Fire Code</i>.</p> <p>The Ministry of Health and Long-Term Care touches on availability through the <i>Long-Term Care Homes Act</i>, which defines elevators as an essential service and monitors maintenance, operation, and outages across regulated homes.</p> <p>The Ministry of Seniors Affairs is responsible for oversight of regulated retirement homes, including associated legislation, regulation, and enforcement. The <i>Retirement Homes Act, 2010</i> sets maintenance standards to ensure homes and their operational systems (e.g., elevators) are in good repair.</p>

Recommendations

1. Define availability as “the ability of a building’s elevating devices to transport persons as and when required”, measured by the handling capacity and uptime of a building’s system of devices

This definition aligns with the characteristics outlined in the ideal scenario: it is clear, understandable, and applicable to all residential and institutional buildings. It also aligns with and builds on International Electrotechnical Commission standards for “dependability” and “availability” of an electrical device. Most importantly, it captures the ability of a building’s devices to function and to move passengers in a timely way.

A two-part metric may be used to measure availability, composed of uptime and handling capacity:

Uptime

Uptime is the time when a device is able to perform as required. It is the opposite of downtime, the time when a device is unable to perform as required, due to internal fault, or preventive maintenance.

Uptime could be measured for all residential and institutional buildings, reported according to a single definition of uptime (hours uptime / year) or collected according to company metrics and converted to a single metric for reporting purposes. I recommend that contractors report the ratio of the downtime and total time, where total time is the sum of the uptime and downtime. Downtime may be estimated as the amount of time that an asset is not able to operate or meet required functions, as laid out below:

Time when the asset is in a failed state (e.g., diagnosis of the problem, logistics time, repair time, checkout time and time to return to operation)	+	Time when scheduled actions (e.g., preventive maintenance) are being performed
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Contractors currently collect downtime as a function of service calls, or total time a device is out of service.

For reporting purposes, the parameters for downtime and uptime need to be precisely defined. Some companies and organizations exclude scheduled maintenance from calculations of downtime, whereas most stakeholders agreed that the calculation of downtime should not need to take into account different reasons for that downtime: if a device is not functioning, the outcome (rather than the reason) is what matters.

Handling capacity

Handling capacity is the ability to move a given percentage of the population over a given time interval. It is a standard design consideration, typically calculated using the standard HC5 methodology.⁴⁸ In practice, handling capacity would be measured for new or converted use buildings to determine the probability of availability. Assessment of adequate handling capacity would only happen at the design stage; it is not affordable or feasible to require existing buildings to meet new handling capacity standards.

As discussed, we heard that availability should deliver five core outcomes: public safety, accessibility, user satisfaction (convenience) and public confidence, housing affordability, and business enablement. The application of this definition should take into account the diversity of stakeholders and policy objectives involved in achieving these outcomes. Any requirements for reporting, measurement, and, if appropriate, regulation should be clear and accessible for building owners, contractors, and residents of Ontario.

2. Conduct greater exploration of the links between safety and availability (accessibility) and the implications across stakeholders

Policymakers and building users need robust data on the state of availability to inform policy and regulation going forward. In general, the evidence gathered to date seems to indicate that non-availability is an issue in specific circumstances and due to a broad range of contributing factors. While there is a lack of evidence on the safety impacts of non-availability, common sense would say there is a clear impact on the accessibility of a building every time an elevator is out of service.

Most recommendations in this report focus on improving the process involved in installing, maintaining, and repairing elevating devices. This will often achieve better outcomes than prescriptive standards (e.g., a maximum number of days an elevator may be out of service, standard maintenance contract terms for all building types and / or populations) that may not apply to a specific situation or may not be feasible to meet or enforce.

As policy discussion on availability continues, however, it will be important to clarify the link between safety and availability.

Multiple stakeholders told us that some components of availability relate to convenience. For instance, able-bodied persons may have to take many flights of stairs to reach their high-rise apartment. Residents may have to wait long periods for an elevator to arrive during busy times of the day.

Other aspects have the potential to impact safety. For instance, first responders may be unable to reach a resident suffering from a heart attack in a timely manner due to lack of elevator service. Tenants with reduced mobility may be unable to leave their home in an emergency. Having said that, there is a perception that defining availability in terms of safety has the potential of putting TSSA

⁴⁸ HC5 refers to the calculation of the proportion of a building's population may be transported by its devices over a given time interval.

inspectors in a conflict position when trying to ensure an elevator is both safe and available. A TSSA inspector might face the decision to keep an elevator out of compliance with safety regulations out of service or to return the elevator to service to restore availability. However, if safety is assumed to take priority over availability in all circumstances, this should not be an insurmountable problem.

It should be noted that there is no empirical evidence that a lack of availability poses a safety risk, when compared with other potential risks monitored by the TSSA.⁴⁹ Technical elevator safety is well regulated and managed in Ontario. Many, however, may perceive availability as being related to safety.

Without question, many perceive elevator availability to be a high priority issue, at least partly from the aspect of accessibility. Common sense tells us that every out of service elevator makes a building partly or wholly inaccessible. Without elevator service, many residents cannot go to work, conduct daily activities, or access their home. Ontario is committed to removing barriers for people with disabilities and Ontarians more broadly in all aspects of public life. Enhancing elevator availability needs to be a part of this effort.

These examples illustrate that of the impacts of elevator availability lie across a continuum, sometimes very close to and perhaps part of “safety”, sometimes to “accessibility” and sometimes to “convenience”. A number of considerations need to be assessed in detail when drawing the link between safety and availability, including any empirical evidence linking a lack of availability to public safety risks.

A risk analysis using TSSA data and expert input estimates the risk of injury or death due to a lack of availability is 0.07 fatality equivalents per million people per year, well below internationally accepted thresholds for acceptable risk to the general population (1 fatality equivalent per million people per year) and to vulnerable populations (0.3 fatality equivalents per million per year).⁵⁰ Further, while retirement and long-term care home elevators were noted as a priority safety area in the most recent TSSA Annual State of Public Safety Report, none of 185 recorded elevator failures in Ontario long-term care homes since 2014 directly resulted in injury or inability to manage a resident’s medical condition.⁵¹ This would indicate that availability is better thought of as an accessibility issue in Ontario.

⁴⁹ The TSSA uses risk of injury or fatality as a measure of acceptable risk from a given activity, calculated using the Disability-Adjusted Life-Years (DALY) metric, a universal health impact metric introduced by the World Health Organization. Preliminary analysis estimates elevator non-availability to have an individual risk of injury or fatality (fatality equivalent) of 0.07 per million people per year, compared to typical risk acceptability criteria of 1 fatality equivalent per million people per year for the general population and 0.3 per million people per year for vulnerable populations (e.g., seniors, persons with health issues). A threshold of 0.5 per million people per year warrants investigation. For more information on methodology, please refer to the TSSA Annual State of Public Safety Report (<https://www.tssa.org/corplibrary/ArticleFile.asp?Instance=136&ID=A6BA4558687E11E5ABDF005056AD4CB7>). Please see Appendix D for detailed methodology and approach.

⁵⁰ Risk of injury or fatality is calculated using the Disability-Adjusted Life-Years (DALY) metric, a universal health impact metric introduced by the World Health Organization. The DALY is the equivalent years of “healthy” life lost due to poor health, injury, and / or premature fatality. Preliminary analysis estimates elevator non-availability to have an individual risk of injury or fatality (fatality equivalent) of 0.07 per million people per year, compared to typical risk acceptability criteria of 1 fatality equivalent per million people per year for the general population and 0.3 per million people per year for vulnerable populations (e.g., seniors, persons with health issues). A threshold of 0.5 per million people per year warrants investigation. For more information on methodology, please refer to the TSSA Annual State of Public Safety Report (<https://www.tssa.org/corplibrary/ArticleFile.asp?Instance=136&ID=A6BA4558687E11E5ABDF005056AD4CB7>). Please see Appendix D for detailed methodology and approach.

⁵¹ For the Annual State of Public Safety Report, 2017, see <https://www.tssa.org/corplibrary/ArticleFile.asp?Instance=136&ID=5FF0487BB36A11E7B91F005056AD4CB7>; The Ministry of Health and Long-Term Care (MOHLTC) tracks specified “critical incidents” in long-term care homes in Ontario, including elevator failures. *The Long-Term Care Homes Act, 2007* contains requirements that all homes be able to provide essential services, including elevators, at all times, or to provide other means to support residents (e.g., staff carrying residents between floors). As per O.Reg. 79/10 General, Section 107, breakdown of major equipment or loss of essential services lasting longer than six hours must be reported to the Home Director within

It should be noted that there is a notable lack of current and historical data on the health impacts of non-availability. The risk assessment relies on expert opinion and several assumptions and should be treated as one input into policy decisions. Further, the potential for indirect health and safety impacts due to a lack of accessibility are not accounted for in this model. Removing barriers to access should be a policy priority, regardless of the frequency, and other secondary impacts (for instance, taking the stairs due to a lack of elevator service and tripping and falling) should be prevented wherever possible. The only way to reduce uncertainty and control for public risk is to collect further data and monitor actual health impacts.

Further study of the links between these concepts should start now and may take several months to complete. This process should be closely aligned with the assessment of options for the management of "Availability".

3. Assess whether TSSA, as opposed to other options, should be responsible for the management of Elevator "Availability" in addition to its current safety mandate

Accountability for elevators is currently dispersed across the public sector, with no organization or coordinated network of organizations tasked with enhancing and monitoring the state of availability. Greater integration of responsibilities related to availability would create greater clarity for building owners, contractors, and residents and streamline the delivery of education and training, policy-making and enforcement, and data collection.

At a minimum, the responsibilities of the accountable organization(s) could include:

- Oversight of regulation and policy concerning elevator availability
- Reporting authority for all future requirements related to availability (i.e., downtime, repair action plans, firefighter elevator outages, etc.)
- Coordination of organizations with existing responsibility for elevators, with the goal to integrate and / or streamline data, monitoring, and enforcement activities as much as possible
- Data analysis and reporting on the state of availability
- Monitoring and enforcement as required by future policy, regulation, or legislation

The issue of responsibility needs to be resolved so that the accountable organization(s) may implement and monitor the success of other recommendations contained in this report as well as broader initiatives related to availability (e.g., policy discussions emerging from debate on *Bill 109*).

I have assessed each of the organizations currently managing aspects related to elevator availability (listed above) to identify a viable "owner" for availability. Note that there might be multiple organizations responsible for components of availability, with an integrated governing body coordinating the whole.

The table below outlines my rationale for why each organization might take part in or handle the majority of responsibility for elevator "Availability" as well as some considerations on the viability of each option. These considerations are not exhaustive. More research is required into the detailed legal and operational implications for each of these organizations if "Availability" were to become part of their mandate.

Organization	Rationale for Responsibility	Considerations
Technical Standards and Safety Authority (TSSA)	<ul style="list-style-type: none"> • Enforces regulations on elevator safety; mandate could be expanded if a link can be clearly established between non-availability and risk to safety 	<ul style="list-style-type: none"> • No clear link has been established between non-availability and risk to safety • An expanded "Availability" mandate could put inspectors in

one business day. Note that data collected prior to 2014 did not specify whether the incident was due to an elevator and that some elevator failures may not have been reported to the MOHLTC.

Organization	Rationale for Responsibility	Considerations
	<ul style="list-style-type: none"> • Holds the most comprehensive set of public elevator data, including device information (e.g., location, building type), maintenance compliance, incidents, major alterations, etc. • Known among building owners as responsible for elevators • Responsible for licensing contractors and certifying mechanics • Established communication with the elevating devices industry, including engineers, contracting companies, mechanics, labour organizations, and consumer / resident associations 	<p>a perceived conflict position if directed to enforce safety and availability</p> <ul style="list-style-type: none"> • The role of inspectors and inspection processes would have to be thoroughly reviewed to reflect a new mandate • As a cost recovery agency, the TSSA would need to review options for funding in light of new demands on capacity, including fees-for-service for reporting and / or inspection. This could increase costs for contractors and owners
Municipalities	<ul style="list-style-type: none"> • Existing responsibility for enforcing the Building Code, with enforcement tools in place (including building permit reviews and construction inspections) • Precedent for regulating elevator availability in existing buildings through Property Standards By-laws (where such by-laws exist) 	<ul style="list-style-type: none"> • There is a lack of consistency in terms of elevator-related expertise, policy, regulation, and enforcement capacity across municipalities • Stakeholders emphasized the need for a coordinated, streamlined approach across the province with respect to elevator availability • Monitoring and enforcement would represent a significant cost burden; further, not all municipalities have the data collection or analysis capabilities required to monitor or enhance the state of availability proactively and over the long-term
Ministry of Municipal Affairs (MMA)	<ul style="list-style-type: none"> • Sets requirements for elevators to meet fire safety and accessibility objectives through the Building Code • Existing relationships with the building industry, including architects and professional engineers 	<ul style="list-style-type: none"> • MMA does not enforce the Building Code. This responsibility is assigned to municipalities and other local enforcement bodies. • The Building Code only applies at the time of construction. Omitting existing buildings from an "Availability" mandate would fail to address some of the core drivers of availability issues. • MMA does not establish or enforce property standards by-laws. This is a municipal responsibility. •

Organization	Rationale for Responsibility	Considerations
Ministry of Government and Consumer Services (MGCS)	<ul style="list-style-type: none"> Responsible for the current laws governing elevator safety and for laws governing consumer protection and condominium regulation Existing resources and expertise in consumer or building owner education and awareness Well-positioned to coordinate between various accountable organizations (e.g., municipalities, TSSA, other provincial ministries) Availability as an accessibility concern would be considered a core policy priority 	<ul style="list-style-type: none"> MGCS enforces certain laws directly and relies on administrative authorities for the enforcement of other laws such as the Technical Standards and Safety Act, 2000 and its regulations MGCS's delivery arm for elevator-related matters would likely be the TSSA
New entity	<ul style="list-style-type: none"> Allows focus on availability Maintains current organizations' scope, focus, and demands on capacity Avoids conflict between existing and new "Availability" related mandates 	<ul style="list-style-type: none"> Stakeholders agreed that a new entity would add an unnecessary layer of bureaucracy and may duplicate existing functions A new entity would be costly to launch and could take several years to be fully functioning

As I have discussed, multiple parties currently have roles in addressing the various factors in a complex issue like availability. Success in dealing with availability will be contingent on a variety of organizations continuing to engage in select responsibilities as appropriate, minimizing burden on one organization. For example, municipalities interested in and able to address maintenance issues through property standards by-laws might continue to do so. Continued, coordinated involvement from a variety of parties will be important in addressing this issue.

Safety must always be the priority over availability. However, looking at the alternatives, it seems logical that some of this responsibility be covered by TSSA given that they have the most in depth knowledge and expertise regarding elevators. Indeed, TSSA may be well placed to coordinate a multi-stakeholder working group involving municipalities, relevant Ministries and agencies for availability reporting and disclosure (Recommendations 4, 7, and 12) to ensure data collection, analysis and reporting is coordinated and streamlined. I have referred throughout the report to a generic "reporting authority" to allow flexibility in this regard.

I understand concerns that the safety and availability mandates may pose a conflict for TSSA inspectors, requiring them to choose between keeping an unsafe elevator out of service or returning it to service to restore accessibility (through availability). Modern regulators often take on multiple objectives within their mandate. If safety is assumed to take priority over availability in all circumstances, this should not be an insurmountable problem.

A dual mandate will strain current TSSA capacity for inspection, enforcement, and data analysis. If the TSSA is to take on responsibilities related to availability, timelines will need to allow for new processes and structures to be developed, with due consideration for other ongoing initiatives. In the meantime, others active in this space (e.g., municipalities with property standard by-laws in place) might continue their activities to ensure coverage in the short to medium-term.

As such, further analysis of the viability of TSSA taking responsibility for availability must be conducted to ensure operational and resource challenges can be addressed and that the new availability mandate does not compromise safety. This analysis should include legal and operational

reviews (e.g., capacity, expertise, new methods of cost recovery), and discussions with senior TSSA management and other stakeholders.

4. Require contracting companies to report data on all downtime. This metric will cover all outages from safety-related matters to regular scheduled maintenance

Policy-makers need a better understanding of the current and evolving state of availability. Contracting companies collect data on downtime as part of tracking service calls and could provide a clear sense of the rate and reasons for outages across Ontario. This data might be aggregated to protect proprietary and competitive interests while also informing policy going forward.

I have not specified a threshold for “acceptable” availability or a threshold at which availability becomes a problem. This could be determined over the course of data collection and consultation with industry and endorsed or even regulated if the responsible authority sees fit. I understand that all elevators will be out of service for some period of time over the course of a year, if only for preventative maintenance and inspection. Industry typically strives for 98% uptime, the equivalent of seven days out of service over the course of a year for the average device.⁵² The industry standard of 98% appears to be a reasonable benchmark to strive for.

Contractors would be expected to record the device license number, the total time (in hours) the device was not able to operate or meet required functions (i.e., carry passengers when they require an elevator) over the course of a year, as well as a brief description of the reason (e.g., scheduled maintenance, unscheduled maintenance, TSSA inspection, modernization). While the exact parameters of downtime need to be defined (as in Recommendation 1), reporting at the outset would cover all outages for any reason. Reporting, while mandatory, could be on a regular (e.g., annual) basis or at the request of the reporting authority (with sufficient notice to allow contractors to collect information).

While initial reporting would include data on total time out of service, additional data needs and potential sources could be identified as valuable. This initiative as a whole will require the development of data collection and records maintenance processes that may pose additional demand for resources and expertise. As such, compiling and analyzing initial and additional data points may require coordination across the supply chain, including contractors, consultants, building owners, property managers, and different levels of government.

The reporting authority might be a single organization or joint venture (see Recommendation 3) but should have or develop the following characteristics:

- Ability to implement a streamlined reporting process, standardized across the province
- Existing knowledge and authority over elevators or similar devices
- Data collection and analysis capabilities, including capacity (e.g., personnel, processes)
- Monitoring or enforcement tools for non-compliance

As discussed, contracting companies record related metrics (e.g., call out time, service calls per device, hours spent servicing equipment) but may need time to incorporate new requirements into internal reporting processes. New policies on recording and reporting should be designed in collaboration with existing reporting authorities (e.g., TSSA for safety reporting, municipal requirements for landlord reporting) in order to align objectives and avoid confusion or conflict for building owners, contractors, and residents.

⁵² Uptime is measured for a building’s system of devices as opposed to an individual device. Based on input from the Toronto Transit Commission, National Elevator and Escalator Association, consulted contractors, elevator consultants, and cited as the Transport for London benchmark (“Lift Availability” (<https://tfl.gov.uk/corporate/publications-and-reports/lift-availability>)).

Finally, while the reporting authority could conduct an initial data review within six months, several years might be required before comprehensive data can be collected and meaningfully analyzed. In the meantime, “pilot” initiatives to collect and analyze data should begin as soon as reasonably possible with the results being used to inform policy and regulation going forward.

II. Enhancing preventative maintenance and outage management

Ideal scenario

Elevators in Ontario have the minimum possible downtime. When downtime is unavoidable due to safety risks, scheduled maintenance, or circumstances beyond the control of owners, contractors, or residents, the device is returned to service as quickly as possible given the circumstances.

Preventative maintenance is performed on a regular basis and in compliance with all safety and availability regulations. Owners have the knowledge and resources to work with their contractor to determine the best routine for each device and are able to maximize the lifecycle of their device and minimize the number of outages along the way.

When breakdowns do happen, **repairs are conducted as quickly and efficiently as possible given the nature of the issue while balancing user and owner interests.** Ongoing communication between owner and contractor ensures the work is done effectively, efficiently, and safely with minimum disruption to residents.

Severe repair delays (over 48 hours as an example) are reported to the accountable regulator and monitored. The situation is monitored to ensure access is restored as quickly as possible, with a focus on the potential impact on residents' health and safety if the outage persists.

Entrapments are rare and resolved quickly through rapid response from appropriate parties who ensure that passengers can safely exit the elevator car. Users in the car know how to call for rescue and are able to reach help 24/7. The building owner, contractor, and fire services follow a standard protocol to determine who is best equipped to respond to the situation. Disruption to other residents is kept to a minimum, as with all outages.

As a source of elevator industry knowledge and expertise, TSSA promotes and undertakes activities including data collection, registration, training, inspections, and enforcement to enhance public safety and resolve emerging issues such as elevator availability.

Acting as a “Modern Regulator” and incorporating broad and frequent industry and other stakeholder input into its decision-making, TSSA collaborates with industry on key technical and strategic matters affecting the industry. Organizations work together to identify and address emerging issues, including availability, and related solutions.

As in any relationship between industry stakeholders and a regulator, mutual trust is an important component.

Current state

Building owners, contractors, and regulators identified **preventative maintenance (and the lack of formalized and standardized processes and regulations) as one of the most significant drivers of non-availability.**

Survey results show that buildings with low availability are more likely to experience outages due to unscheduled maintenance or TSSA shutdown, indicating issues that might have been resolved through effective maintenance. Fault-tree analysis based on TSSA data and expert input estimated that equipment breakdown and related unscheduled maintenance required was responsible for approximately 70% of elevator non-availability over the course of a year.⁵³

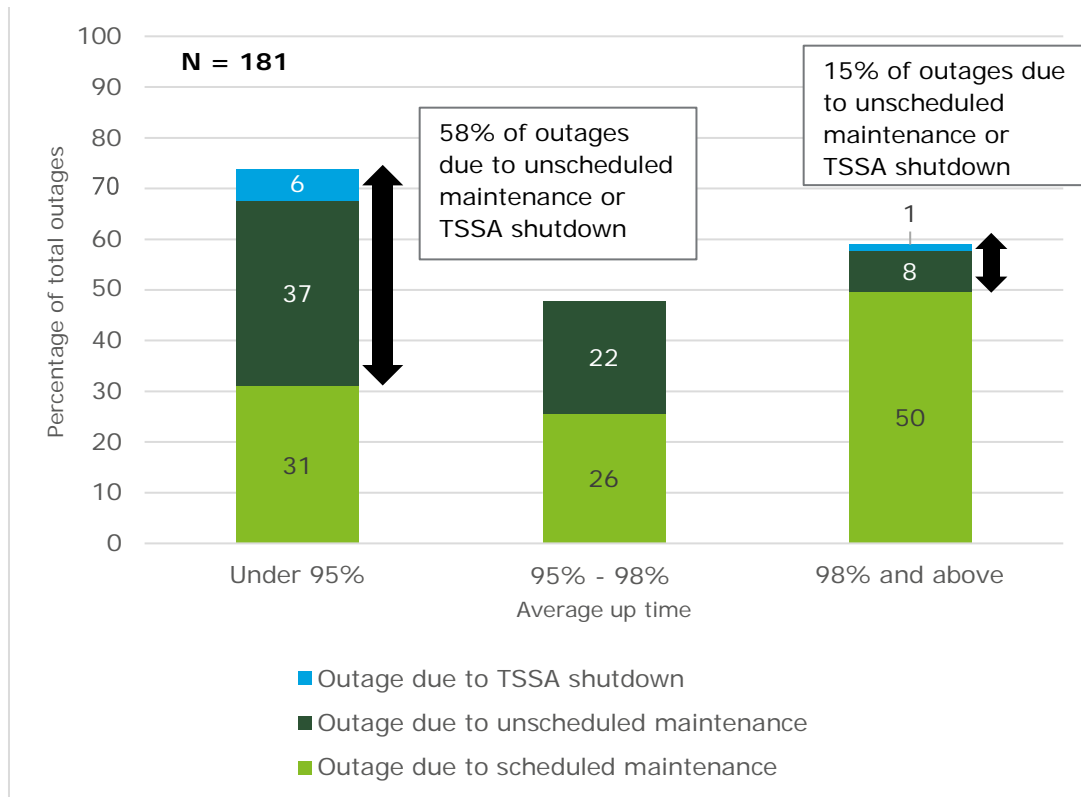


Figure 4 – Top reasons for outage by uptime⁵⁴

There are currently no minimum preventative maintenance standards in Ontario to minimize future availability issues.

The Maintenance Control Program (MCP) sets minimum maintenance requirements, including quarterly and semi-annual maintenance tasks, device-unique procedures (e.g., hydraulic pressure test) and annual (Category 1) and 5-year (Category 5) safety testing. The TSSA administers and inspects for MCP compliance. An MCP plan ensures an elevator is maintained appropriately throughout its lifecycle, with varying maintenance frequency based on environment, equipment characteristics and usage. MCP came into effect in Ontario in 2014 in order to harmonize with ASME A17.1/CSA B44 Safety Code for Elevators and Escalators standard. The program is used internationally and will soon be in force in British Columbia.⁵⁵

⁵³ Equipment breakdown refers to instances not resulting in safety incidents. Frequency estimates were made using a combination of TSSA data and expert opinion. Further assessments should address any assumptions made to arrive at estimates, based on more robust TSSA and industry data.

⁵⁴ Deloitte license holder survey results. Note that these represent a subset of the total reasons for outage, based on frequency of response. As such, totals do not add to 100 and a small subset of potential reasons are represented.

⁵⁵ The Maintenance Control Program was developed in line with the ASME A17.1 / CSA B44 standard, the North American harmonized safety code for escalators and elevators.

However, compliance with TSSA annual periodic tasks and scheduled maintenance tasks has continued to trend downward. Despite the introduction of MCP, compliance is sitting at 22% across all buildings and an average of 20% for residential buildings (see Figure 3).

According to TSSA records, specific contractors or buildings seem to drive low compliance, while others complete adequate maintenance according to regulation.

The TSSA has found that poor compliance with MCP usually indicates low compliance with other safety requirements. Owners and mechanics who comply with MCP requirements typically discover other repair or maintenance needs in the process, identifying problems early, driving effective and timely maintenance and likely improving overall availability.

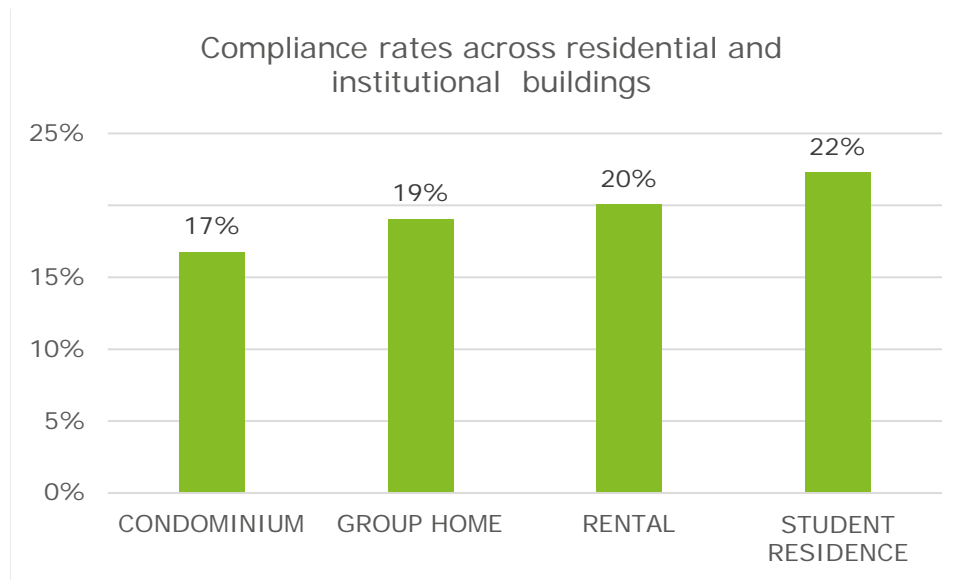


Figure 5 – Regulatory compliance rates across residential and institutional buildings, 2017⁵⁶

While the introduction of MCP was a positive measure specifically to increase safety (with a potential downstream impact on availability), many stakeholders told us the program is not working as intended in Ontario today.

Contracting companies claim that increased requirements for testing have driven a higher number of hours spent servicing devices since the program came into effect without a clear impact on safety outcomes.⁵⁷ Building owners claim that MCP has resulted in reduced frequency and thoroughness in maintenance as minimum requirements have changed from monthly to quarterly visits. Dissatisfied residents put fault with the building owner while acknowledging that both owner and contractor may be responsible.

A lack of preventative maintenance over time will likely lead to more frequent repairs and a shorter time between modernizations. According to industry experts, contractors, and building owners, aging elevators are often not maintained or modernized at the appropriate time due to lack of awareness of

⁵⁶ TSSA data on compliance with regulatory requirements, as per the *Technical Standards and Safety Act, 2000* and related regulation.

⁵⁷ TSSA data has found poor compliance with MCP does not strongly correlate with poor safety records.

device lifecycle needs or due to the high cost associated with modernization, in turn increasing the likelihood of non-availability.⁵⁸ .

Even the best maintained elevators will break down at some point for any number of reasons. Industry data tells us that 98% of devices are returned to service within twenty-four hours.⁵⁹ That said, the same industry data tells us that approximately one percent of devices go into “long-duration” shutdown over the course of a year.⁶⁰ Surveyed license holders reported that four per cent of devices had outages of over three weeks during the past year.⁶¹ Elevators out of service for over 24 hours typically require rare parts, mechanic expertise, or major alteration or repair.

As discussed, contractors and building owners identified preventative maintenance and parts availability as the key drivers for breakdowns and for how long downtime lasts. Generally, a regularly maintained device requiring routine or readily available parts will be back in service quickly, while delays in sourcing parts or a lack of ongoing maintenance may result in longer outages.

Building owners told us that slow response times or a lack of available, qualified mechanics may be adding to the time an elevator is out of service. Owners reported being precluded from engaging mechanics from companies other than their contracted maintenance company even when that mechanic might be able to reach the building and diagnose the issue more quickly.

A number of factors can cause delays in repairs, some within the control of owners or contractors and some beyond anyone’s control (see Figure 6).

⁵⁸ Analysis of survey and TSSA data did not identify a correlation between the date of an elevator’s installation date or last modernization (whichever was most recent), safety record, or level of availability. This indicates that age is most likely to impact availability when combined with other factors such as a lack of preventative maintenance.

⁵⁹ According to data from elevator contracting companies representing service records for 5500 devices and expert consultation.

⁶⁰ “Long-duration shutdowns” is the term used by industry reports to describe outages of over a week, most often due to major issues such as flood or fire damage or obsolete equipment that may take weeks or months to address through no fault of the building owner or contractor.

⁶¹ Survey results are based on a sample of building owners. While broadly representative, survey respondents may have experienced more long-duration outages than the average device owner, accounting for the discrepancy between contractor and survey data.

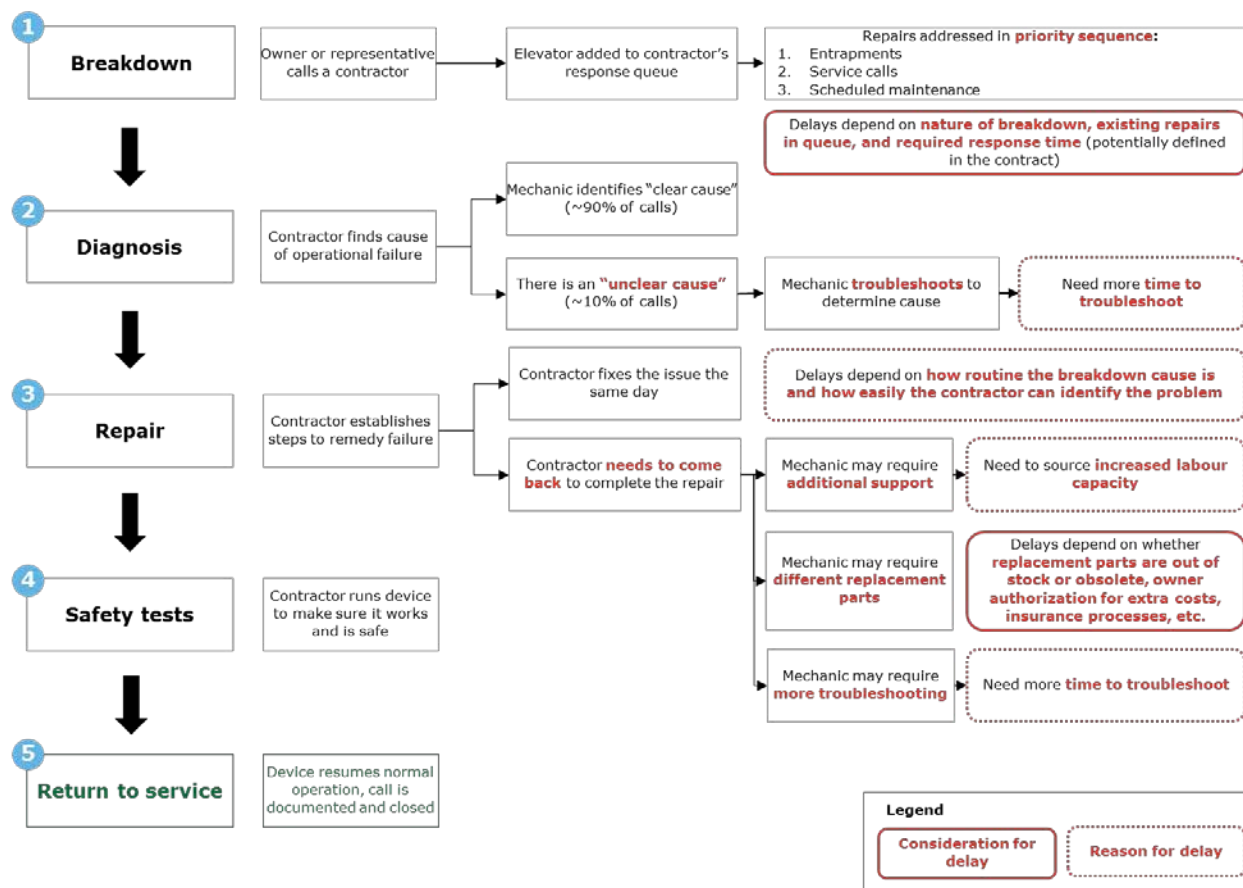


Figure 6 - Sample repair process map⁶²

Owners are responsible for the state of the elevators but may have limited ability to assess maintenance quality. Further, owners may have limited knowledge of effective preventative maintenance practices, requirements for alteration or modernization, or the condition of a device.

Finally, entrapments may also cause disruption in service, which impacts safety and accessibility. Entrapments occur relatively rarely; given the rough estimate that Ontarians take 657,000 elevator trips per day, a user would have a 0.004% chance of entrapment.⁶³ According to the National Elevator and Escalator Association, contractors documented approximately 9,649 entrapments across residential and institutional buildings in Ontario or about 26 per day in 2016, down 18%-20% over the past three years.⁶⁴ Ontario firefighters responded to 4,467 calls for entrapments across all building types, or about 12 per day, in 2015. While this represents an 18% increase in calls since 2012, "persons trapped in elevators", represent 1% of all calls responded to by Ontario fire services.⁶⁵

⁶² Note that this is a sample maintenance process. It is a generic representation based on expert contractor input and does not capture all possible maintenance processes, unique circumstances, or potential delays.

⁶³ Number of trips calculated based on number of passenger elevators in Ontario and approximate number of passenger journeys a day, based on calculations from the National Elevator Industry, Inc. (<http://www.neii.org/presskit/printmaster.cfm?plink=NEII%20Elevator%20and%20Escalator%20Fun%20Facts.cfm>)

⁶⁴ National Elevator and Escalator Association. (September 2017). Reliable Elevators – How Ontario Can Become a National Leader for Transportation Systems in Buildings.

⁶⁵ Data from Office of the Fire Marshal and Emergency Management, coded as "person trapped in elevator".

The discrepancy in reported numbers is largely due to a lack of clarity on **how passengers and building owners are reporting the problem**. The passenger might use the elevator's emergency call system, call the owner or emergency services from their cell phone, or attempt to self-extract. Sometimes the building owner will be notified and will call a contractor directly. Sometimes the fire department will be called. This results in dispersed accountability for efficient entrapment response and management.

TSSA guidance states that a trapped passenger should contact the building owner or owner's representative, who might then contact a contractor for rescue assistance or to return an elevator to safe operation after an entrapment has occurred.⁶⁶ In practice, entrapments are only recorded by contractors in circumstances where the owner is on site, is aware of the entrapment, and calls the contractor. Entrapments recorded by fire services deal for situations where a person is trapped in an elevator and fire services is called, either by the trapped individual, another resident, or through an emergency alert system.

On all of the above issues, we heard a variety of concerns from industry regarding the consistency of regulations and effective communication with industry. In particular, contractors and consultants in the industry believe that they are not adequately engaged in strategic decision-making on areas of expertise including maintenance and modernization. It was widely acknowledged that the Elevating Devices Advisory Council has provided a valuable, executive-level forum for industry input. However, many felt that the relatively new endeavour needed to be built upon by allowing members to take on a more strategic advisory role and by increasing collaboration in decision-making.

Some have expressed strong views that accountability for availability cannot reside within their current mandate, which is focused on safety. Linkage of these two concepts, they argue, has the potential to introduce a conflict between enforcing availability and enforcing safety, impeding current processes and thereby weakening Ontario's strong record for safety.

Recommendations

5. Assess options to enhance MCP effectiveness to ensure that devices are adequately and proactively maintained and that compliance is met

TSSA data shows that compliance with MCP correlates with better overall maintenance practices. This can in turn enhance availability by keeping the elevator in its best possible condition and identifying problems early, allowing contractors to plan for repairs and minimize disruption for users. Further, MCP takes into account unique characteristics related to a device's environment, equipment, and usage, allowing contractors to design a plan best suited to that device.

Higher compliance with MCP is likely to drive more effective maintenance practices overall, with a significant impact on both safety and availability. The TSSA and industry should collaborate to consider how the MCP program might be improved, including how to drive better overall compliance, balance the responsibility between owner and contractor for non-compliance, and enhance program credibility with building owners and contractors. Regulations should be modernized to better reflect the appropriate responsibilities of all parties without losing the collaboration needed.

The TSSA has identified many of these issues and is presently conducting an analysis which hopefully will provide better solutions. I would encourage consideration of the following actions if they are shown to be impactful, feasible, and enforceable:

- Restore minimum monthly frequency for maintenance if devices fall below a specified threshold for safety compliance and / or downtime (as reported; see Recommendation 4). If

⁶⁶ Director's Information Bulletin Ref. 267-13. (June 7, 2013).
<https://www.tssa.org/corplibrary/ArticleFile.asp?Instance=136&ID=F47B6AB63D8F11E3A78800C2922855A>

device performance is above the specified threshold, allow minimum quarterly maintenance (as in the current state). Performance records might be reviewed on a schedule, either determined by device risk score or conducted annually. While this option may increase the cost of maintenance for contractors and, in turn, building owners, cost avoidance could also incentivize better performance

- Explore the use of administrative monetary penalties (AMPs) to drive compliance. AMPs might be applied to the contractor as well as the owner, or alternately shared by both, in order to spread the onus for non-compliance among all responsible parties. Fines would need to be set at a level that encourages good maintenance practices and does not simply become the cost of doing business
- Employ the full set of enforcement tools currently available to the TSSA, including license revocation for contractors and device owners. License revocation has not been used frequently in the past due to the heavy burden of proof required. Review of this option should include suggestions on how to make this process more efficient and effective where appropriate

Regardless of the option chosen, I would encourage the TSSA to explore the root causes of non-compliance as well as how to disseminate best practices from those contractors in full compliance. Given the potential significance of improved compliance with MCP, I would recommend settling on a course of action within six months. Given that any required regulatory amendments may take 1-2 years to implement, the sooner implementation starts the better. Further, regular review and assessment of the MCP program should be conducted to continue identifying barriers to compliance and areas for improvement. The compliance issue is well known and solutions should be actioned immediately.

6. Provide education and awareness services for owners on effective preventative maintenance, “end of device lifecycle” and other capital planning, and related topics

Owners we spoke to described having little ability to influence the maintenance of their device. Many owners, particularly non-professional landlords such as new condominium owners or long-term care home operators, lack the technical knowledge to assess whether their contractor is performing adequate maintenance, whether the device is in good condition, or what a device might require over the course of its lifecycle. Owners may not be investing in more comprehensive contracts or appropriately timed modernization if it seems too expensive or if the impact on tenants is not clearly understood. Better-informed owners are equipped with the knowledge they need to provide top service to building residents. It is in their business interest to keep these users happy as well as to minimize repair costs that may arise due to poor maintenance.

Greater awareness and education would empower owners to encourage effective maintenance practices through contractual agreements and to invest in appropriate maintenance. Member associations (e.g., the Federation of Rental Housing Providers), the TSSA, and various municipal programs (e.g., RentSafeTO) might leverage existing services for minimal additional cost or effort. Further research should consider which existing offerings have been most effective in order to apply lessons learned.

Some proposed additional preventative maintenance standards or requirements as an alternate option to protect owners against inadequate maintenance. I believe additional standards would increase the regulatory burden for owners and contractors and would be difficult to apply and enforce across buildings. MCP is an internationally recognized procedure for preventative maintenance. Efforts should first be made to enhance compliance with the program in place. These efforts will be supported by greater education and awareness. Programming also allows providers the flexibility to respond to evolving knowledge gaps and new technologies. It should be noted that education may incentivize good owner and contractor behaviours but does not directly enforce compliance.

7. Require contractors to report outages over 48 hours or when 50% of the elevators are out of service, with a defined action plan to restore service. The action plan should include clearly defined owner / contractor responsibilities

Bill 109, Reliable Elevators Act, 2017 proposes requirements that an out of service elevator be repaired within 14 days for most buildings and seven days for long-term care homes and retirement homes. *Ontario's Housing Plan* also proposes establishing timelines for elevator repair to increase elevator reliability in Ontario buildings.⁶⁷ We heard a broad consensus from building owners and contractors that this is unworkable. While building owners and consumer associations representing residents told us they and their membership would appreciate assurance that action is being taken to rectify the situation, they also recognized that a broad range of issues might reasonably extend repair needs and timing beyond fourteen days.

This range of reasons, as well as the potential for debate around what is a “reasonable” cause for exemption runs the risk of invalidating the requirement. Many expressed concern that repair timelines might prompt contractors to refuse service or significantly increase charges for older equipment as the device might require more time to repair (e.g., due to obsolescence of parts or general wear). We also heard that elevator repair times could actually increase with prescriptive timelines, as contractors could prioritize repairs to meet the timeline rather than the actual, potentially shorter, time needed for repair. All of this might result in additional costs for building owners and, potentially, residents. Finally, the development and negotiation of appropriate contract terms to meet new requirements could result in significant additional cost to owners and, in turn, building users.

My recommended alternative to mandatory repair timelines is to introduce a requirement for a plan of action in cases of prolonged outage or “emergency” lack of service. Recording all outages that last over 48 hours would incentivize action in a shorter timeframe than seven or fourteen days, both because the accountable regulator would be aware of the outage and because contractors will want to avoid additional administrative and cost burden. Recording all cases in which 50% or more devices in a building are unavailable would address non-availability before the building has no service at all. Contractors should record the outage and prepare an action plan if either of these conditions are met (i.e., an elevator is unavailable for longer than 48 hours **or** 50% or more of devices are unavailable for any period). This is not simply an exercise in data collection, but provides the regulator with the ability to monitor and oversee the repair process. Whichever entity plays a future role in elevator availability, support will be required for the significant costs expected for additional personnel and net new capabilities.

I note that modern regulators are taking on more of a coaching role for industry stakeholders in addition to their core mandates. This will be an opportunity for industry and the regulator to work together to find solutions. I recognize that there may be legitimate causes for outages lasting longer than 48 hours. However, this recommendation will allow the regulator to document and manage such situations as efficiently as possible.

The proposed timelines appear to be aligned with industry practice: many of the contracts we reviewed specify a 24-hour response time for non-emergency calls. A 48-hour window would give contractors an additional 24 hours to return the device to service, the average time for 98% of devices today.⁶⁸ Further consultation with building owners, contractors, and the regulator should confirm whether this timeline is reasonable and feasible.

⁶⁷ Ontario's Fair Housing Plan (2017). <https://news.ontario.ca/mof/en/2017/04/ontarios-fair-housing-plan.html>

⁶⁸ Estimate based on reports from the National Elevator and Escalator Association and industry experts consulted. National Elevator and Escalator Association. (September 2017). *Reliable Elevators – How Ontario Can Become a National Leader for Transportation Systems in Buildings*.

While contractors are best positioned to report outages, contractors and owners share the onus for follow-up action. This is appropriate as issues and therefore solutions involve joint responsibilities. As such, both parties should have access to action plans at all times. I suggest acceptable plans include, at a minimum:

- Outage details (e.g., reason for outage, the time the contractor was called, the time the contractor arrived, identification of cause)
- Reason for reporting (e.g., delay due to parts availability, 50% or less availability)
- Plan of action and approximate timeline to restore service, with clearly defined roles and responsibilities (i.e., contractor, owner)

Exceptions or reduced requirements might be introduced in cases where temporary or partial unavailability (e.g., someone using an elevator to move) results in 50% or fewer of devices being available. Similarly, some buildings might be exempt from the requirement (for instance, a building under a certain number of storeys with one device might be exempt from reporting when 50% of devices are unavailable).⁶⁹

Reporting, while mandatory, could be on a regular (e.g., annual) basis or at the request of the reporting authority (with reasonable advance notice or ad hoc audit). Audit of action plans could initially focus on whether plans are being completed and evolve to assessing the adequacy or content of plans. This evolution will require the marshalling of expertise across the industry, potentially including consultants and building officials. The frequency and depth of audits could be increased for those contractors submitting multiple action plans to determine the root cause of issues (e.g., device / building condition, owner action, contractor action).

Reporting should be seen as a reasonable cost of doing business without being overly onerous for contractors. Streamlined reporting through a standard online or hard copy template would minimize cost and time for contractors and for the accountable regulator. Contractors would know in advance what basic information is required and the regulator could easily review action plans, with in depth assessments for adequacy reserved for special circumstances (i.e., a device with multiple action plans submitted, a device with an elevated risk score, a building with no accessibility due to elevator outage).

Reporting requirements will generate data on prolonged outages and allow the appropriate authority to identify buildings or devices with recurring issues. A streamlined approach to reporting will allow for analysis and comparison across building types, populations, and regions. With no exemptions allowed, this alternate meets and exceeds the intention of *Bill 109* and *Ontario's Fair Housing Plan* while remaining workable for the contracting industry.

This recommendation represents a significant shift in reporting requirements and will require development of new processes, both on the part of contractors and the entity responsible for collecting and assessing plans. I see a number of options for who might be responsible for collecting and holding the data as well as for mediating any disputes that may arise in the creation of the plan:

Organization	Rationale for Responsibility	Considerations
"Availability" Authority (e.g., TSSA)	<ul style="list-style-type: none"> • Holds primary responsibility for elevator availability, including responsibility for collecting and holding contractor data on 	<ul style="list-style-type: none"> • TSSA does not currently have the capacity or expertise to collect, assess, and enforce (if required) action plans

⁶⁹ 39% of residential and institutional buildings with elevators in Ontario have one passenger device. Calculated from TSSA datasets; Elevating Device License by Installed Device Number (<https://www.tssa.org/corplibrary/ArticleFile.asp?Instance=136&ID=D01283642B5911E7B91F005056AD4CB7>) and building type from Risk-Based Decision Data (<https://www.tssa.org/corplibrary/ArticleFile.asp?Instance=136&ID=97C3A5772B5711E7B91F005056AD4CB7>)

Organization	Rationale for Responsibility	Considerations
	<p>uptime; harmonization of reporting requirements will allow data to be aggregated and analyzed within one organization</p> <ul style="list-style-type: none"> • Possesses existing knowledge of and access to the elevating device industry • Holds access to industry expertise through the Elevating Devices Advisory Council and the Field Advisory Committee that might contribute to developing action plan templates and assessment criteria 	<ul style="list-style-type: none"> • Initiative would be out of the current scope of EDAC and FAC, representing a more operational role • The scope of expertise and capacity required may be better addressed by a multi-stakeholder group • As a cost recovery agency, the TSSA would need to review options for funding in light of new demands on capacity, including fees-for-service for collection and audit. This could increase costs for contractors and owners
Consortium of elevator consultants	<ul style="list-style-type: none"> • Could authorize or “certify” acceptable plans so the “Availability” authority’s responsibility consists only of collecting certified plans • Would possess the knowledge and expertise required to assess the adequacy of action plans, to mediate conflicts between parties developing action plans, and to propose alternatives • Already have strong working relationships with contractors, building owners, and other industry players • Could possess a range of expertise (construction as well as repair; technical maintenance and contract practices) 	<ul style="list-style-type: none"> • There is no coordinated body of elevator consultants; this group would need to be created and given the mandate and resources to carry out activities • Puts information on elevator availability out of the public domain; clear protocols would need to be established to ensure coordination and regulator access to information • Further assessment is needed to determine how the consortium would be funded and managed • The “Availability” authority could endorse the consortium and set key outcomes, with defined performance metrics and review cycles
Consortium of industry experts	<ul style="list-style-type: none"> • Could authorize or “certify” acceptable plans so the “Availability” authority’s responsibility consists only of collecting certified plans • Would possess the knowledge and expertise required to assess the adequacy of action plans and to propose alternatives 	<ul style="list-style-type: none"> • Puts information on elevator availability out of the public domain; clear protocols would need to be established to ensure coordination and regulator access to information (potentially related to Recommendation 4) • Composition of the consortium would need to be determined (e.g., contractors only, contractors and builders, etc.); the level of existing coordination between these experts will depend on the composition (i.e., contractor associations exist today, but cross-expert groups do not) • Depending on composition, building owners may feel as though the consortium is biased

Organization	Rationale for Responsibility	Considerations
		towards contractors in assessing plans <ul style="list-style-type: none"> • Further assessment is needed to determine how the consortium would be funded and managed • The “Availability” authority could endorse the consortium and set key outcomes, with defined performance metrics and review cycles

Given the above considerations, I would recommend a hybrid approach that will allow expertise to be marshaled most appropriately for each situation. While the “Availability” authority is to be determined based on further analysis, this authority could bear some responsibility for holding the action plans collected and associated data. While recognizing that existing regulators do not possess the expertise or capacity required to assess the acceptability of plans, I believe a consortium with diverse representation and strong relationships with industry and owners would be best positioned to assess plans as well as to mediate any disputes that might arise between owners, contractors, and consultants in developing a plan. Representatives could include consultants, engineers, contractors, or other persons determined to have relevant expertise.

This will require detailed implementation planning, including identification of the organization accountable for availability (see Recommendation 3), planning for how the action plan requirement will be put in place, and the cost, expertise and capacity required to collect and monitor action plans (including the most appropriate reporting mechanism and consequences for non-compliance). As such, this initiative might take one to three years to put into action.

8. Establish a consistent protocol for communication and accountability in case of entrapments, including emergency notification and communication between the owner, contractor, and first responders

A consistent protocol for communication in case of entrapment will provide clarity for building owners, contractors, first responders and, most importantly, building users, including those in the device and those unable to use the elevator. The development of this protocol might mean formalizing existing practices.

The TSSA provides information for owners on what to do in case of entrapment that might be harmonized with firefighter and contractor standard protocol.⁷⁰ The protocol might also integrate data on entrapments so that the organization responsible for implementation can continue to monitor and address the issue going forward.

While industry uptake should be monitored over the long-term, new protocols might be in place as quickly as three months. Further assessment will be needed to identify who should own these protocols, whether municipal fire services, the TSSA, or another organization. A formal protocol might be complemented by educational material published by the responsible organization for both owners and users on the best means of minimizing entrapments and dealing with them when they do occur.

⁷⁰ TSSA Elevating and Amusement Devices Safety Division. Director’s Information Bulletin No. 263 / 13. <https://www.tssa.org/corplibrary/ArticleFile.asp?Instance=136&ID=F47B6AB63D8F11E3A78800C2922855A>

9. Review options to enhance the efficacy of the Elevating Devices Advisory Council in providing a forum for industry consultation, input and advice

Many from industry we spoke with see great value in the Elevating Devices Advisory Council (EDAC). It is seen as a forum for communication between the elevating device industry, users, government representatives and the TSSA as well as a positive step forward in the relationship between stakeholders and the regulator.

It is important to maintain this relationship and to ensure EDAC is serving its function as a strategic advisor to government as well as a source of input. Further, EDAC needs to stay relevant as the elevator market and regulatory environment evolves. I propose the following key questions, based on regulatory best practice, as a framework for review:

- How frequently does the existing process result in recommendations to government on possible changes, including to legislation and / or regulations (e.g., annually)?
- How are relevant stakeholders identified and invited to join the process and in what capacity?
- How are appropriate representatives of relevant groups identified?
- How does the process support and enhance existing policy development processes?
- What level of transparency surrounds the outputs of the process?
- How does the process align with existing policy initiatives, such as the Open for Business Initiative?

This review might be conducted by the TSSA, in partnership with EDAC, or by a third but related party (such as the Ministry of Government and Consumer Services). The TSSA and EDAC would have first hand knowledge of successes and challenges to date, while a third party would lend independence and objectivity. As the process should include meaningful consultation with industry, up to six months should be allowed to complete the review and further time to analyze the results and form an action plan.

10. Develop an annual industry satisfaction survey to help identify opportunities for greater communication and collaboration with industry

As a complement to EDAC, the TSSA should continue to seek opportunities to communicate and collaborate with industry more broadly. In order to target resources and efforts, an annual industry satisfaction survey might help to identify what is working well and what could be improved in the relationship between regulator and industry. The results could be used to document key issues and track progress over time.

Accountability for the installation, operation, and maintenance of elevators is currently shared by industry, building owners, the TSSA, and government. Continued evolution in the way the regulator and industry communicate will improve coordination on issue identification, data collection and other tactical initiatives while also increasing general goodwill between the regulator and the sector as both try to improve elevator availability. Many contractors and elevating device professionals felt as though they were not adequately consulted in the development of *Bill 109* or on other recent policy decisions regarding single-speed elevators. Fostering these relationships will facilitate partnership and implementation going forward.

The objective of the survey is to provide the TSSA with future access to industry knowledge and experience on technical matters, while also allowing the broader industry community to know their concerns and ideas are being heard. If the satisfaction survey on its own does not achieve these outcomes, further work should be done to engage with industry and across government to identify

more impactful initiatives. I recommend the initial survey be designed and launched in parallel with or as part of the EDAC review (see Recommendation 9).

III. Developing improved education and awareness for elevator owners on key availability topics

Ideal scenario

Market-based competition is driven by user choice, with active and informed users putting pressure on contractors to improve services. The elevating device market, including installation, operation, maintenance, and modernization, functions efficiently and effectively enhances availability. Strong competition is driven by user choice. Active users apply pressure on firms to improve their product offerings, in part by looking for opportunities to switch providers. When a device is not available, building users are aware of the reasons for outage, measures being taken to return the device to service, and estimated duration of outage.

Contracts facilitate a “fair” marketplace: while minimum service standards are in line with owner expectations, there is an opportunity for higher value “premium” services for those willing to pay more.

Building owners include adequate maintenance and modernization in long-term capital and other financial planning. Building owners have the knowledge, capacity, and choice to maintain devices in such a way as to meet availability standards.

Current state

User knowledge and choice is limited in the current environment. Users here might mean the building owner negotiating services with a contractor or the building user requiring an available elevator, whether for safety, accessibility, or convenience.

Despite an increasing pool of contractors and service options, some owners report service standards not meeting minimum expectations while some report that price competition has resulted in curtailed maintenance services. Some owners of residential and institutional buildings told us they lack the technical knowledge and expertise to negotiate balanced contracts or advocate for improved service. Other owners with limited technical knowledge may defer modernization or engage in less comprehensive maintenance service packages due to cost. Finally, owners are often unaware of or unprepared for the cost of maintenance or replacement over a device’s lifecycle.

Education and training needs, access to resources, and fiscal capacity appear to vary depending on a number of factors:

- **Building type:** Owners and property managers reported information asymmetry to be a much larger problem in the residential and institutional sector than the commercial sector
- **Portfolio size:** the negotiating power and knowledge of a sophisticated management company with several hundred buildings compared with an independent landlord with fewer than five buildings
- **Structure and formality of ownership:** the differences between a condominium board, a property management company acting on behalf of an owner, and a single owner in terms of direct influence over maintenance and repair services

An owner’s technical knowledge and ability to advocate for good services can directly influence availability. For instance, I can see that best practice contracts can be powerful tools to enhance

availability. Some owners that have adopted these practices over time now achieve over 99% uptime across their large portfolios of residential buildings.⁷¹ These practices include:

- Service standards for “uptime”, sometimes incentivized through performance-based contracting or customer rebates
- Comprehensive preventative maintenance terms
- Parts availability guarantees, with specification that the contractor shall bear the cost or inform the owner of the cost prior to replacement
- Maximum allowable response time, inclusive of regular and outside-regular working hours
- Clear cancellation clauses for failure to meet performance requirements or contract terms

I also saw examples of broad variation between contracts. Key differences include:

- **Duration:** there was a lack of consensus on whether longer or shorter-term contracts were preferable for industry and building owners. Most agreed that a mid-length duration incentivizes best results. The contractor can spread costs over a longer period of time and is therefore incentivized to invest in the device. The owner can work with the contractor to ensure the device is being serviced appropriately
- **Obsolescence:** contracts define a part’s obsolescence differently, sometimes because it is no longer manufactured, sometimes due to the difficulty in sourcing it, sometimes due to the cost of sourcing
- **Availability:** availability is rarely referred to explicitly but may be enhanced through references to response time, uptime, or call-back ratio

The most effective contracts balance comprehensiveness for the owner with level of liability for the contractor by adjusting contract duration, services included, and definition of terms. While building owners are ultimately responsible for building assets and services, including elevating devices, they may have less technical knowledge relative to the technical experts brought in to develop, construct, install, and maintain amenities for their building. A robust industry of elevator consultants have emerged over the past 20 years, helping owners negotiate for their maintenance and device needs.

Issues with availability related to market failure are passed on to the user public. This public is also at a disadvantage in advocating for better service. As discussed, there is little if any public access to data on the actual state of availability. New tenants rarely have access to information on elevator amenities in a building and are therefore not given the choice to factor it into purchasing decisions (as they might with walkability, proximity to schools, etc.). Critically, building users with accessibility issues may not be prepared for barriers if given no notice of service disruption.

There are currently no universal requirements that owners engage in capital planning or that elevators be included in plans, although the practice is common among “best practice” owners. In an effort to encourage this behaviour, the recently passed City of Toronto apartment standards by-law requires apartment building owners and operators to have a current state of good repair capital plan, consisting of capital elements of a building (including elevators) and a date when each element will be updated or replaced.⁷² C.19, s. 93 (6) of the *Condominium Act, 1998*⁷³ requires that a condominium corporation’s reserve fund account for major repair or replacement of assets, including elevators. Additionally, elevator consultants frequently provide advice and guidance to owners on how to plan for the lifecycle of their device.

⁷¹ Based on data and input from building owners and property management company representatives with large residential holdings.

⁷² Toronto’s New By-Law for Apartment Buildings. (<http://www.toronto.ca/legdocs/mmis/2017/ls/bgrd/backgroundfile-101418.pdf>)

⁷³ Condominium Act, 1998 (<https://www.ontario.ca/laws/statute/98c19#BK204>)

Recommendations

11. Develop education and awareness services for owners on topics including contract terms, elevator regulation, consultant services, etc., delivered through a combination of government, broader public sector organizations and building associations

Education and training will help to correct information asymmetries that prevent owners from advocating for balanced contract terms, effective maintenance, and timely repair. This approach is intended to be low cost for owners and government and in line with modern regulatory principles, avoiding prescriptive regulations and onerous enforcement requirements. While it puts the onus on the market to continue to self-regulate and negotiate contracts in good faith, it does so by balancing the market, in parallel with enhanced reporting requirements and public disclosure of outcomes.

Existing programs delivered by the TSSA, business associations, and municipalities might be leveraged to minimize additional cost and content development.⁷⁴ The organization responsible for delivery and the channel for delivery could be determined by topic, based on expertise and capacity. As an example, the TSSA might be best positioned to provide awareness resources on existing elevator regulation, while the new Condominium Authority of Ontario might be best equipped to train owners on standard maintenance contract terms.⁷⁵

Some feel that elevators in private dwellings need increased oversight, potentially including regulation of the installation, maintenance, and repair on par with elevating devices regulated under the *Technical Standards and Safety Act, 2000*.⁷⁶ While private dwelling elevators are out of scope for this report, I believe explicitly extending resources to owners of these devices will encourage appropriate maintenance and repair planning and practices, ensuring safety and reliability across elevators.

While education and training will do little to help those in existing unbalanced contracts, it may empower these owners to advocate for better service and become aware of the resources that exist to support them (including consultant services). Further assessment should determine which existing offerings have been most effective and through which methods or channels.

12. Explore opportunities for greater disclosure of information to existing and potential building users about elevator maintenance / disruption, status of repairs, etc.

A greater emphasis on availability as a factor in user decision-making could incentivize owners to invest in the availability of their elevators, in part through robust maintenance programs and a thorough understanding of resident needs. We heard from the public as well as community associations and building owners that reliable, consistent communication around the reason for service disruption and the action being taken to remedy the situation would help to set expectations and accommodate any barrier to accessibility.

⁷⁴ Examples include TSSA webinars, Federation of Rental Housing Providers resources and templates, RentSafeTO renter and owner resources, elevator consultancy blogs, etc. The Condominium Authority of Ontario's Condominium Director Training Program makes training on a number of topics available to condominium owners, residents and members of the public, including the regulatory environment for condominiums, relevant authorities, and financial management (<https://www.condoauthorityontario.ca/en-US/training/director-training-overview/>)

⁷⁵ For more information on the Condominium Authority of Ontario, please see <https://www.condoauthorityontario.ca/en-US/>

⁷⁶ O.Reg. 209/01: *Elevating Devices*, Section 2.3 specifies that regulation does not apply to elevating devices in or in connection with private dwelling houses used exclusively by the occupants and their guests.

A number of options might be assessed for how to communicate more effectively with residents. The new City of Toronto Apartment Buildings By-Law⁷⁷ and RentSafeTO program include specific obligations for landlords to communicate with existing tenants on the status of maintenance and repairs.⁷⁸ Disclosure in this case could mean posted notices or emails to residents. Another model might mimic real estate websites that disclose walkability and other amenities as part of the appeal of a property. Information on elevator availability might be disclosed by building owners and aggregated by municipalities or another government entity (e.g., MGCS) for use by existing building users and potential buyers.

Disclosure incentivizes availability through market mechanisms. Required communication is intended to increase transparency around areas of good behaviour and areas of concern. Communication is not, however, a replacement for effective management of outages and communication does not compensate residents for safety, accessibility, or convenience issues experienced while the elevator is out of service.

Options for disclosure can be assessed immediately, with implementation timelines to be determined. This assessment should consider the level and feasibility of enforcement. For instance, landlords or building owners may not feel they have to respond to incentives for better service in a tight rental market where existing and prospective tenants have little choice of residence. The strength of enforcement should balance the need to ensure compliance with the associated burden on the enforcement authority for limited return value.

13. Establish a public database of elevator uptime by address, with data voluntarily disclosed by contractors

While Recommendation 4 suggests that contractors report downtime to allow the reporting authority to analyze, monitor, and address issues with availability, public disclosure presents a distinct but related opportunity to enhance availability. A public database of data on uptime could act as an additional incentive for building owners and contractors to enhance availability as a way of attracting tenants (for owners) or increased business (for contractors).

Public access to “availability” across buildings and over time would allow residents to assess and set expectations for the state of availability in their building. Recommendation 12 also speaks to disclosure but focuses on service disruption to building users and residents. This database would allow the public to assess availability across buildings and benchmark their own building against the standard.

While Recommendation 4 requires that contractors report downtime (easily converted to uptime), any data made public would be disclosed on a voluntary basis and presented in aggregate to protect competitive interests. A variation of this recommendation could also be a database for owners only, with their discretion to make it available to residents as well.

I would strongly encourage contractors to consider this “full transparency” option. Disclosure of availability benefits a number of groups:

- Contractors may rank and advertise their own performance relative to competitors
- Building owners might attract new tenants while allowing existing tenants to compare their building’s performance against others
- The public would be given an accurate picture of the state of availability, which could be used as an advocacy tool for improvement

⁷⁷ City of Toronto By-Law 448-2017, Chapter 354, Apartment Buildings (<http://www.toronto.ca/legdocs/bylaws/2017/law0448.pdf>)

⁷⁸ See RentSafeTO: Apartment Building Standards Program (<https://www1.toronto.ca/wps/portal/contentonly?vgnextoid=7bd4b8d74b4db510VgnVCM10000071d60f89RCRD>)

- Government would be fulfilling priorities relative to Open Government initiatives and could use the data to develop policy and improve availability

Private sector models such as addressreport.com and rentlogic.com provide a similar service, aggregating data to rank rental properties in New York City based on their amenities (including elevators).⁷⁹ In addition to consumer knowledge, this type of database could provide a transparent record of availability over time, allowing for ongoing measurement, informed policy discussion, and continuous improvement.

Three options could be assessed for managing the database:

- 1) **(Recommended) Availability authority managed:** The single organization or one of a network of organizations responsible for monitoring and enhancing availability would be best suited to host this database, both as the recipient of contractor data on downtime and as the “public face” of availability. This would avoid confusion for the public and for contractors reporting data and would maintain a “single authority” on the subject of availability
- 2) **Managed by Ministry of Government and Consumer Services or Technical Standards and Safety Authority:** Either organization might take responsibility for the public disclosure component of “Availability” (if neither is the single accountable organization or if they are both part of a network of responsible organizations). The TSSA has the most comprehensive existing set of public elevator data, while MGCS management would align with its consumer protection mandate and clearly distinguish between availability and safety data
- 3) **Managed by an independent third party:** an independent private organization (e.g., rentlogic.com) or industry-led consortium (potentially organized through existing associations such as the National Elevator and Escalator Association or the National Elevator Industry, Inc.) would maximize independence and may facilitate disclosure from contracting companies hesitant to release data to regulators

Establishing a public database will require time for identification of an “owner”, set-up, and data collection. The government might work with existing models (e.g., [RentLogic.com](https://rentlogic.com)) to expedite implementation, but the process may still require several months.

Regardless of model, public disclosure requires voluntary commitment and collaboration from a number of diverse and often inter-competitive stakeholders. It may generate collaboration, coordination, and trust among industry actors as well as the public going forward but may also have a number of unintended consequences that should be monitored and minimized where possible. Contracting companies may have limited ability to collect and provide data in a timely way. While predictive modelling for outages may be possible in future, access at this point will only address past rather than real time availability issues. Finally, data must be used to enhance availability through the whole supply chain. Building owners should not be penalized for poor records that they only partially control.

14. Encourage proactive “end of life” policies that build parts, maintenance needs, and cost of modernization into capital planning through targeted education, training and resources

Long-term capital planning for elevator maintenance and modernization allows owners to plan financially for their asset management needs, minimizing elevator service disruption while distributing lifecycle costs over the long-term. A robust asset plan should include guidelines for elevator upgrades, replacement, and other major service requirements. Industry perspective is that asset plans can minimize breakdowns, provide better resident service, and save repair costs over the long-term.⁸⁰

⁷⁹ See <https://rentlogic.com/search> and <https://www.addressreport.com/>

⁸⁰ The National Elevator and Escalator Association recommends “[Ensuring] all building owners have an asset plan in place so that obsolete, unreliable or unsafe elevators are updated periodically” (National Elevator and Escalator Association. (September 2017). *Reliable Elevators – How Ontario Can Become a National Leader for Transportation Systems in Buildings.*)

Owners might be encouraged to engage in appropriate long-term planning through existing requirements (e.g., City of Toronto Apartments By-Law , and reserve fund and training requirements for condominium board directors under the *Condominium Act, 1998*) or as a core part of the educational offerings suggested in Recommendation 11. The organization accountable for availability might publish official materials, templates and other resources, or might coordinate publishing through a respected authority such as the TSSA, other DAA (e.g., the Condominium Authority of Ontario), MGCS, , MMA, or municipalities, to highlight the importance of the issue.

As with other educational offerings, this option can build on existing best practices, consultant offerings and legislation in place. While owner uptake should be monitored over time, initial implementation could happen over the next six months.

IV. Developing guidelines for the capacity of elevators required in new buildings

Ideal scenario

All new buildings are equipped with elevator capacity sufficient to transport the current and anticipated building population in a timely manner at high peak time. Capacity takes into account the possibility that a building's purpose or main user base may change over time. The number of devices allows for availability even if one or more elevators are out of service.

The sufficient number of elevators is determined following a standard, transparent, and repeatable process. This process aligns with international standards and industry best practice and is adaptable to different building types, populations, and regions.

Current state

Presently, there are no regulated standards regarding the number of elevators required in a residential or institutional building, other than in the situations described below. For certain types of building projects, elevator traffic analyses are regularly conducted during the building design phase to assess how many elevators should be installed based on building type, height, population, and desired level of service. The developer ultimately decides how many devices to install and this decision is made, in part, based on cost (e.g., impact on leasable space), target level of service, and expected building use.

Under-elevated buildings have been identified by both industry stakeholders and associations representing consumers as a significant driver of non-availability. 80% of all residential and institutional buildings in Ontario have one or two elevators.⁸¹ Among the buildings that participated in the license holder survey, there is no strong correlation between the number of devices and the number of storeys in a building.

Ontario's Building Code includes requirements for elevators in certain new buildings and for clearly defined purposes. For example:

- At least one firefighter elevator is required in residential buildings that are more than 18 metres in height;
- At least one elevator is required in care and treatment facilities that provide services above the ground floor level; and
- Elevators may satisfy barrier-free path of travel requirements in large buildings.

⁸¹ Calculated from TSSA data.

The Building Code also references recognized industry design and safety standards for newly installed elevators.

Bill 109 proposes denying permits to any new building with seven or more storeys unless an elevator traffic analysis “conducted in accordance with industry standards” showed the building had a reasonable elevator traffic capacity. Formal industry standards do not exist currently and *Bill 109* did not define what a “reasonable” capacity would entail.

Several international standards-setting bodies, including the Chartered Institution of Building Services Engineers (CIBSE) and the British Council of Offices (BCO) provide specifications for elevator capacity based on the developer’s performance goals (e.g., average waiting time for passengers). While the International Standards Organization (ISO) is developing a standard on the process for elevator traffic analyses, methodology may vary based on region or building context.

Recommendations

15. Work with a recognized standards organization (e.g., CSA Group, UL Canada) and qualified persons to develop an industry standard that new residential buildings above a certain height and / or number of units contain a minimum number of elevators. The standard would be referenced in Ontario’s Building Code

There was broad consensus among those consulted that elevator service is required for safety, accessibility, and convenience. This is true of all buildings where residents have no other means of travel above the ground floor (for instance, a person in a wheelchair or a senior with reduced mobility). While one elevator may ensure some access, availability is lost completely if that single elevator goes out of service.

Municipalities, including the City of Oshawa, have considered requiring a minimum of two elevators to be operational at all times where installed.⁸² Sweden’s National Board of Housing, Building and Planning (Boverket) building regulations require one elevator for all residential buildings that have more than four storeys and two elevators be installed in buildings with more than ten storeys.⁸³ China’s Design Code of Residential Buildings has similar requirements for buildings over seven and over twelve storeys, respectively.⁸⁴ Hong Kong’s Building Authority⁸⁵ and the UK’s Local Authority Building Control (LABC)⁸⁶ have similar regulatory requirements to ensure barrier-free access for all building users.

⁸² In 2015, the City of Oshawa examined proposed requirements for all multi-level buildings to have more than one elevator as a remedy for situations where a building’s sole elevator breaks down. The new City of Hamilton Property Standards by-law includes requirements around elevator operability, with different requirements and levels of urgency for restoring operability depending on the total number of devices servicing the building.

⁸³ National Board of Housing, Building and Planning. Boverket (Building Regulations). <http://www.boverket.se/globalassets/publikationer/dokument/2016/boverkets-building-regulations--mandatory-provisions-and-general-recommendations-bbr-23.pdf>

⁸⁴ Johansson, G. & Sköld, J. (Spring 2014). Housing standards: Development of design codes in Sweden and China.

⁸⁵ Section 5.7.2 of the Design Manual for Barrier-Free Access (put out by the Building Department) specifies that every floor of a building should be accessible by at least one lift as an obligatory design requirement. Alternate measures may be proposed if a builder is unable to meet the design requirement. This applies to all new domestic buildings of more than four storeys or all non-domestic buildings as well as those same undergoing major alteration or addition. Building regulations in Hong Kong are enforced by the Buildings Department through prosecution. (http://www.lwb.gov.hk/eng/consult_paper/BFA_ch5.pdf)

⁸⁶ Approved Document Part M: Volume 2 – Buildings other than dwellings provides guidance on how to meet building regulations in the United Kingdom. The building regulations on access to and use of buildings provide a baseline for accessibility in the built environment and require access to all storeys in a building. Approved Document M2 suggests that all new developments and existing buildings have a passenger lift serving all storeys, except where site constraints (e.g., a new building in a historical town centre, an existing building not reasonably able to undergo renovation) prohibit meeting the requirement. In such cases, a number of alternatives are

Following this example, Ontario should explore minimum requirements for the number of devices in buildings over a certain number of storeys or with particular user needs. I recommend this standard be referenced in the Building Code as part of Ontario's commitment to accessibility in the built environment. The Building Code already includes numerous references to CSA Group/UL Canada standards and might follow a similar process for this requirement. If implemented, this requirement would be assessed by Chief Building Officials as part of the permitting process for all eligible new buildings.

Standards should take into account concerns about affordability. Minimum requirements could increase capital and maintenance costs for owners, reduce leasable floor space, restrict builder design options and flexibility and decrease affordability for residents. Working with a recognized standards organization, however, would allow the Ministry of Municipal Affairs to study the applicability and implications of new requirements for new residential and institutional buildings in Ontario.

The standards development process typically involves a committee of experts with knowledge and expertise in a given area. The Building Code Act, 1992 identifies specified individuals and firms as qualified and registered to carry out regulated activities, including building officials, some designers, and registered code agencies hired to carry out inspections. These experts should be engaged early and often throughout the process.

In addition, Ontario has a growing and robust community of elevator consultants that might be leveraged to recommend industry leading methodologies and / or appropriate elevator capacity across all buildings. The term "elevator consultants" encompasses a variety of firms with a wide range of professional experience; consultants do not belong to a self-regulated professional body. Services and areas of expertise may include maintenance program audits, modernization studies, new construction studies, specification and contract review, and project management. Consultants already perform elevator traffic studies for many owners as part of these services and have strong working relationships with developers, contractors, and the regulator.

An insufficient number of elevators will continue to be a more significant issue with every year as the number of new high-rise buildings increases. While the consultation, review and development of new standards could take up to three years to complete, I would urge policymakers to consider ways to implement measures as quickly as possible.

16. Work with a recognized standards organization (e.g., CSA Group, UL Canada) and qualified persons to develop an industry standard for conducting elevator traffic analyses, to be referenced in Ontario's Building Code

There seems to be broad agreement that elevator traffic analyses should be conducted for all new buildings. While I support the recommendation in *Bill 109*, policy-makers must first develop a standard for elevator traffic analyses to ensure the process is standard, transparent, and repeatable across residential and institutional buildings and across regions. As in Recommendation 15, this standard might eventually be referenced in the Ontario Building Code and enforced by Chief Building Officials as a required part of the permitting process. This recommendation aligns with other Ontario Building Code regulations that advance Ontario's commitment to accessibility in the built environment.

Standards could be harmonized with recognized international standards including the Chartered Institution for Building Services Engineers (CIBSE): Guide D and the pending ISO/WD 8100-32. A consistent process will also allow adaptability to new technologies or usage patterns that may evolve more quickly than legislation or regulation.

As in Recommendation 15, code-designated qualified persons as well as well-regarded elevator specialists familiar with the design, operation and maintenance of elevators should be core members of an eventual Standards Development Committee for new capacity standards. This will enhance the technical rigour of the exercise while leveraging deep knowledge of the Ontario market. The appropriate channel(s) for engagement of qualified persons and of persons not belonging to a professional body (i.e., consultants) should be assessed to ensure robust input.

suggested. Building regulations are enforced by local authorities in their area, with tools including prosecution or legal orders for non-compliance.

While this would be confirmed in the standards development process, elevator traffic analyses could be required for certain building types with higher occupant loads and would further refine requirements determined by the standard referred to in the previous recommendation. I would recommend the standard for a minimum number of elevators take precedence over the outcomes of a traffic study. That is, if a traffic study determines a building needs three elevators, that number will be installed. If a traffic study determines a building needs one elevator, two elevators would be installed. This is to avoid confusion for designers, developers, and Chief Building Officials.

A period of adjustment may be required for the building industry to adopt new standards. As with standards for minimum requirements, a period of up to three years could be required for development. Again, I would urge policymakers to seek ways to complete the process as quickly as possible, leveraging existing industry practices and collaboration with key stakeholders. Cooperation from industry will be critical in identifying existing best practices and to build the capacity of building officials to assess the adequacy of traffic analyses.

V. Reviewing regulations and industry practices to enhance labour mobility and availability

Ideal scenario

There is a sufficient supply of highly skilled and qualified mechanics available to provide services as required. There are adequate mechanics to respond to calls for service within industry standard times (less than two hours) and to complete repairs effectively and efficiently.

A clear pathway to support apprenticeship completions and certification is in place. Barriers to a mechanic's path to Class A certification, including employment opportunities and other unique circumstances, are removed as possible.

Current state

Stakeholders had **divided views on whether there were enough qualified mechanics** in the province of Ontario to effectively maintain an increasing number of devices and respond to breakdowns in a timely way.

Some building owners and consumer organizations suggested that a lack of qualified elevating device mechanics (EDMs)⁸⁷ might be affecting availability by reducing responsiveness and increasing repair times. The problem does not appear to be a lack of EDMs but rather a lack of growth in the number of Class A mechanics (see Figure 5). Union data further suggests that some EDM-A mechanics may be underemployed as trainees.⁸⁸

⁸⁷ The Elevating Devices Mechanic is a trade regulated by the Ontario College of Trades and Apprenticeship Act, 2009. Qualified individuals may obtain a Certificate of Qualification, which confirms its holder has the skills, knowledge and experience that meet industry standards of practice for the trade.

⁸⁸ Data from the International Union of Elevator Constructors suggests that approximately 5% of unionized Class A mechanics are unemployed or underemployed (i.e., working as trainees).

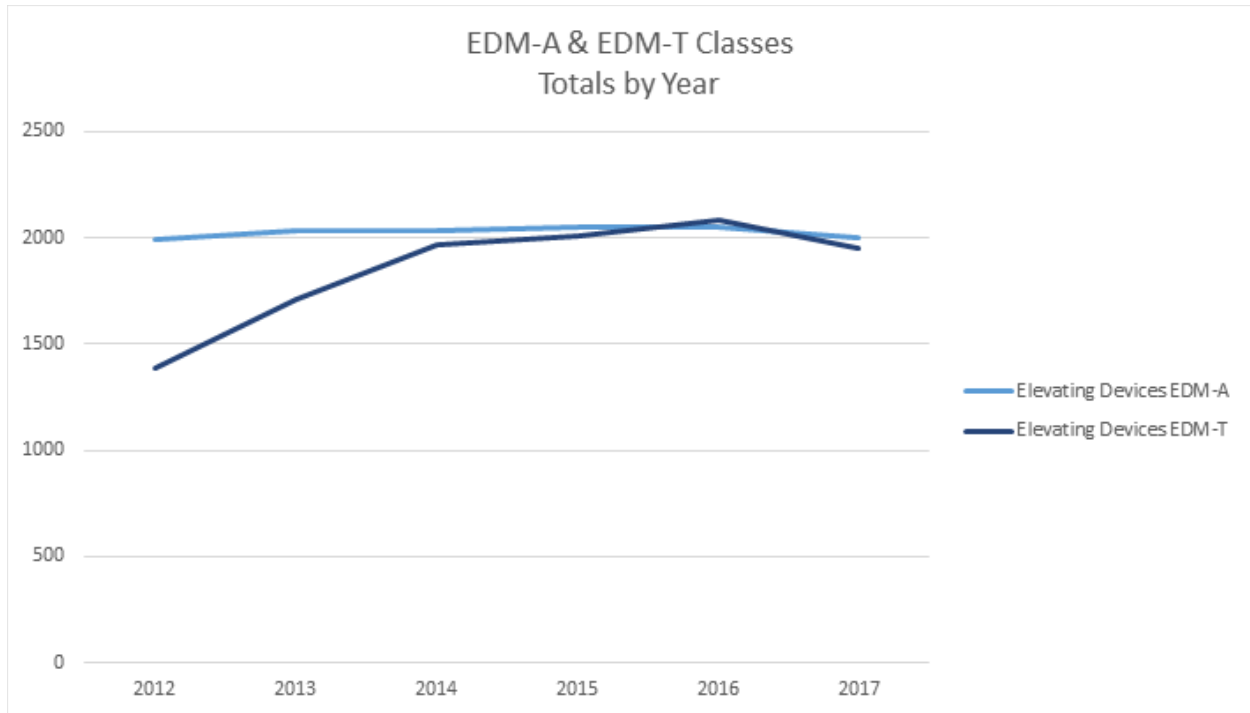


Figure 7 - EDM-A and EDM-T certifications by year⁸⁹

According to building owners and contractors consulted, this is in part because mechanics are servicing up to four times as many devices per route as 15 years ago. This may be because technology has made service calls more efficient or may be because companies are servicing more devices as the price of maintenance contracts has decreased.

Recommendations

17. Amend Technical Standards and Safety Act regulations to include a “sunset clause” for EDM-T certification, requiring EDM-Ts to pursue further training within a given time frame

Ontario needs qualified mechanics to address issues before and as they occur. While technological advances may mean a single mechanic can service more devices, the overall increase in high-rise construction means elevator mechanics will continue to be in demand. The sector has capacity to meet demand through training and certification programs at Durham College and the Canadian Elevating Industry Educational Program (CEIEP).

I recommend introducing a maximum allotted time for EDM-Ts to take the required steps to achieve their Class A certification. This might mean EDM-T’s are required to provide proof they are pursuing further education and / or setting an absolute time after which EDM-T certification expires. This will encourage continuous learning for trainees operating in the field. It also increases the pool of fully qualified labour, making it more efficient for industry to employ Class A as opposed to Class T mechanics.

This option has been considered by the TSSA in the past and work is underway to assess feasibility. Barring necessary timeline extension for regulatory amendment, recommendations for implementation

⁸⁹ Calculated from TSSA data.

could be ready within a year. I encourage the TSSA, industry, the Ontario College of Trades, and union representatives to collaborate to assess demand for Class A mechanics and identify barriers for trainees pursuing further classification.

One recommendation we heard was the creation of a new class of mechanic to address routine or “simple” tasks, creating more capacity for Class A mechanics to address complex or emergency situations. I am not satisfied there is evidence at this stage to conclude that a new class of mechanic would significantly alleviate tasks for Class A mechanics. A new class, in fact, might re-create the current situation with EDM-T’s, growing a lower qualified labour pool while failing to address the scarcity of highly qualified mechanics. I believe that focus should be on encouraging mechanics to progress through existing classes as opposed to creating further levels.

As noted above, I would encourage the TSSA, OCOT, and industry partners to continue to assess how the journey to Class A mechanic might be structured to encourage mechanics to build competencies while meeting demand for services.

VI. Providing reliable elevator access for all first responders

Ideal scenario

In cases of emergency, first responders are able to access the person in distress as quickly as possible. First responders include firefighters, paramedics or police. These professionals should have equal authority and capacity to respond to an emergency, with no delays due to low or no elevator availability.

Current state

All residential buildings over 6 storeys or 18 metres in height are required to have a firefighter elevator.⁹⁰ There are also provisions under Part 7 and Part 9 Retrofit of the Ontario Fire Code to ensure the presence and operability of firefighter elevators for residential buildings. There is currently no specific requirement to notify the fire department if the firefighter elevator is not operational. An out of service firefighter elevator may significantly delay emergency response time as well as reduce overall elevating device capacity in the building.

In emergency situations, first responders have the ability to take control of a building’s devices in order to reach the fire, medical issue, or other emergency. This is known as emergency recall, or Firefighter Emergency Operations (FEO). Division B, Section 3.2.6.4 of the Ontario Building Code specifies that elevator keys to recall an elevator manually in case of an emergency shall be:

- a) Provided in a suitably identified box conspicuously located on the outside of an elevator hoistway near the central alarm and control facility, and
- b) Kept at the central alarm and control facility⁹¹

In practice, an emergency responder arriving on the scene of an emergency may access this key by either locating the box or retrieving the key from the on-site building supervisor. In order to equip emergency services personnel with one key, a TSSA Director’s Order requires all devices installed after 2008 use a common FEO-K1 key, the universal standard key as designated in the ASME A17.1 Safety

⁹⁰ Specifications are detailed in the Ontario Building Code Division B Article 3.2.6.1.

⁹¹ See Ontario Building Code: Division B, Section 3.2.6.4

Code for Elevators and Escalators.⁹² Elevators installed prior to this date may need a manufacturer specific key.

In some Ontario municipalities, fire trucks are equipped with FEO-K1 and other common keys to reduce delays to response time while the firefighter finds the key box or on-site supervisor.⁹³ This also means the on-site key is available for other first responders (e.g., paramedics) so that multiple elevators can be used to respond to fire or medical emergencies.

While the FEO-K1 key is available for elevator personnel, emergency personnel, elevator equipment manufacturers, and other authorized personnel, only firefighters receive comprehensive training on how to use the key. First responders told us that delays in locating the key and common technical mistakes in using the key could add to response time. This will particularly affect paramedics who arrive first at the scene of an emergency and require the key to access a medical emergency. There was a high degree of consensus among stakeholders that all first responders should have equal ability to respond to emergencies.

Recommendations

18. Revise the Ontario Fire Code to require owners to notify the fire department, occupants and supervisory staff when a firefighter elevator is not operating for more than 24 hours

We heard from first responders, the Office of the Fire Marshal and Emergency Management, and building owners that elevator access can be critical in case of emergency. Any unexpected delay to response time can increase the risk to resident health and safety. Notifying the fire department will not put a firefighter elevator back in service, but it would help firefighters and other first responders better prepare for the situation.

Similar requirements exist in the Ontario Fire Code for when a standpipe, hose system, or fire alarm system is out of service. New reporting requirements would also generate valuable data on entrapments, health and safety incidents related to lack of elevator access, and the general state of availability in Ontario.

We heard broad consensus on this recommendation and I believe implementation could be initiated within the next three months. The total duration of implementation will need to be determined as the Code change process unfolds. This process should include robust consultation and comprehensive review. A reporting protocol for owners as well as the capacity of fire services to collect data will need to be assessed. These reports might then be distributed to the organization accountable for availability to be compiled with records of downtime and outages, streamlining the process for reporting.

19. Train all first responders to use a universal key in emergency situations

Further research should be done to substantiate whether lack of access for paramedics has been an issue with the associated level of risk to health and safety. However, common sense would indicate that extending universal key training to other first responders will enhance capacity to respond to emergencies, decreasing the potential health and safety risk for those living in the upper storeys of high-rise buildings. While the regulation allows key access for all first responders, we heard that non-firefighter first responders were often untrained on how to find and use the key. There was also a perception among the building owners and property managers we consulted that the key was for firefighter use only. Training would address this lack of clarity while also enhancing the effectiveness of emergency response.

⁹² Elevating and Amusement Devices Safety Division. Ref. No. 22/06 (July 27, 2006).

⁹³ Toronto Fire Services equips frontline vehicles with an FEO-K1 and MP1 key. The decision to equip trucks with FEO keys would be made by individual Fire Services.

First responders and building owners we spoke to were in favour of this recommendation. Implementation could begin over the next three months, working with regional fire and paramedic organizations as well as other first responder organizations. As a first step, responsible bodies will need to be identified to provide training to existing and new personnel in a simple, streamlined, and cost efficient way. I would recommend municipal fire services or the Office of the Fire Marshal and Emergency Management consider extending existing training to other emergency services personnel, depending on capacity.

Considerations for Implementation

The recommendations I have outlined above are intended to enhance availability across residential and institutional buildings in Ontario. My hope is that they address existing issues while at the same time ensuring that the market is able to function as intended.

In order for these recommendations to be successful, I believe the following considerations should be assessed:

- The capacity of all industry participants to provide robust and comparable data relevant to availability without negatively impacting their proprietary interests
- Prioritizing evidence-based policy even if that imposes reasonable delays on the timing of *Bill 109, Reliable Elevators Act, 2017* or any similar initiatives related to this topic
- The ability of all stakeholders to drive towards and be accountable for the five core availability outcomes
- The effectiveness of communication, education, and collaboration among industry, government, key stakeholders, and the broader user population people
- Further analysis of the option of TSSA taking responsibility for availability, without compromising safety. This would include legal and operational reviews and discussions with senior TSSA management
- The ability of all organizations accountable for availability-related initiatives to build capacity for any new activities
- The coordination of standards and regulations across Canadian jurisdictions and levels of government

With these conditions in place, I hope to see this province become a leader in elevator availability, improving safety, accessibility, and convenience for residents of Ontario.

Appendix A – Glossary of Terms

Average waiting time: A typical amount of time a user waits for an elevator, derived by dividing total time spent waiting by the total number of elevating devices. Average waiting time can be denoted in seconds or minutes.

Call out time efficiency: The average time taken to return inoperable elevator systems, elevating devices, or device components to normal functioning service.

Dependability: The ability of an elevating device to perform as and when required. Dependability includes availability, reliability, recoverability, maintainability, and maintenance support performance, and, in some cases, other characteristics such as durability, safety and security.

Downtime: The amount of time that an elevating device is not able to operate or meet required functions.

Entrapment: When an elevator experiences mechanical or operational failure while passengers are inside.

Handling capacity: The number of passengers transported by an elevator in an observed time period.

Incident: An occurrence involving an elevator system, an elevating device, or a component of an elevating device resulting in adverse consequence to a person or property. Consequences are generally associated with an injury – ranging from minor first aid injuries to fatalities.

Maintainability: The probability of performing a successful repair action within a given time. Measuring the ease and speed with which an elevating system, device, or component can be restored to operational status after a failure occurs.

Maintenance support performance: Ability of a maintenance organization, under given conditions, to provide upon demand, the resources required to maintain an elevation system, device, or component under a given maintenance policy.

Modernization: The process of upgrading the critical components of an elevation system or elevating device in order for it to handle new technologies, have better performance, improve safety, and update aesthetics.

Near miss: An event that exposes a hazard that does not result in injury to elevator passengers or damage to property.

Reliability: The ability of an elevating device to perform as required, without failure, for a given time interval, under given conditions.

Supportability: The characteristics of a device that allows it to continue functioning normally without need of extensive repair costs or maintenance outages.

Uptime: The amount of time that an asset is able to operate at normal capacity and meet all required functions.

Appendix B – Jurisdictional Findings

Research Topic	New York City	Vancouver	Chicago	London	Hong Kong	Singapore
Population ⁹⁴	8,537,673	2,463,431	2,704,958	8,787,892	7,374,900	5,607,283
Population density ⁹⁵ (population by km ²)	10,935	856	4,594	5,590	6,544	7,797
High rises ⁹⁶	6,291	691	1,200	1,722	7,852	5,758
High rise density (population / # of high rises)	1,357	3,565	2,254	5,103	939	974
Number of high rises in development ⁹⁷	~300	~70	~220	~280	~120	~40
High rise types ⁹⁸ (e.g., % institutional, residential, commercial)	48% Residential 35% Office 8% Hotel 9% Other	53% Residential 23% Mixed-use 18% Office 6% Other	51% Residential 28% Office 10% Mixed-use 11% Other	68% Residential 20% Office 8% Mixed-use 4% Other	75% Residential 17% Office 3% Mixed-use 5% Other	53% Residential 31% Office 7% Hotel 9% Other

⁹⁴ Population Statistics for Countries, Administrative Areas, Cities and Agglomerations. (<https://www.citypopulation.de>)

⁹⁵ Ibid.

⁹⁶ <https://www.emporis.com/statistics/skyline-ranking>

⁹⁷ Emporis categorizes high-rises as buildings between 35 and 100 meters tall, or at least 12 floors high, whether or not its height is known. Buildings of unknown heights and 12 to 40 floors high are also categorized as high-rises. High-rises are categorized by Emporis apart of skyscrapers, which are considered by Emporis to be buildings at least 100 meters tall. Numbers provided in this table include both high-rises and skyscrapers (as per Emporis' definitions of). (<https://www.emporis.com>)

⁹⁸ The Skyscraper Center (<http://www.skyscrapercenter.com>). Results for buildings under 150m maybe be incomplete.

Research Topic	New York City	Vancouver	Chicago	London	Hong Kong	Singapore
Definition of high rise	A building with an occupied floor located more than 75 feet (22,860 mm) above the lowest level of fire department vehicle access ⁹⁹	A building having not less than five storeys and consisting of three or more dwelling units which do not have separate, individual access to grade ¹⁰⁰	Any new or existing structure over 80ft above grade which is also of occupancy classification: A (Residential), C(Assembly), D(Open Air Assembly), E (Business), F(Mercantile), or G(Industrial) ¹⁰¹	N/A	N/A	N/A
Definition of elevator / elevating device	All the machinery, apparatus and equipment directly used in raising and lowering in a vertical or substantially vertical direction,	Any apparatus, mechanism or device that is installed or positioned for the purpose of raising, lowering, moving, carrying, conveying or	A hoisting and lowering mechanism, equipped with a car, that moves within guides and serves two or more landings as defined in Section 1.3 of	A lifting appliance— (a) serving specific levels, (b) having a carrier moving along guides which are rigid and inclined at an angle of more than 15	(a) a lifting machine or appliance having a carrier the direction of movement of which is restricted by one or more guides; or (b)	Any power-driven permanent equipment installed in or attached to a building or structure (a) by which people or

⁹⁹ NYC Building Code (2014). (<https://www1.nyc.gov/site/buildings/codes/2014-construction-codes.page#bldgs>)

¹⁰⁰ City of Vancouver Bylaws. (<http://www.bcpropertyfinder.com/zoning/zoningbylawdvnv.pdf>)

¹⁰¹ Chicago Building Code. (<https://www.cityofchicago.org/content/dam/city/depts/cfd/general/PDFs/HighRiseStudyGuide.pdf>)

Research Topic	New York City	Vancouver	Chicago	London	Hong Kong	Singapore
	persons or freight in a car, or platform operating in permanent guides or rails. This does not include dumbwaiters ¹⁰²	directing persons, materials or goods ¹⁰³	ASME A17.1-2007 ¹⁰⁴	degrees to the horizontal, or along a fixed course even where it does not move along rigid guides, and, (c) intended for the transport of— (i) persons, (ii) persons and goods, or (iii) goods alone, if the carrier is accessible, that is to say a person may enter it without difficulty, and fitted with controls situated inside the carrier or within reach of	a mechanized vehicle parking system, but does not include an escalator; ¹⁰⁶	goods are raised or lowered within a car or cage, or on a platform, in a substantially vertical direction; and (b) the movement of which is restricted by a guide or guides, and includes the supporting structure, machinery, equipment, gear and enclosures used in

¹⁰² New York State, Division of Safety and Health, 12 CRR-NY 8-1.1. (<https://labor.ny.gov/workerprotection/safetyhealth/sh8.shtm>)

¹⁰³ Safety Standards Act, Elevating Devices Safety Regulation. (http://www.bclaws.ca/Recon/document/ID/freeside/13_101_2004#section1)

¹⁰⁴ Elevator Safety and Regulation Act. (<http://www.ilga.gov/legislation/ilcs/ilcs3.asp?ActID=2472&ChapterID=24>)

¹⁰⁶ Code of Practice for Lift Works and Escalator Works. (http://www.emsd.gov.hk/filemanager/en/content_805/CoP_le_Works_with_appendices.pdf)

Research Topic	New York City	Vancouver	Chicago	London	Hong Kong	Singapore
				a person inside the carrier ¹⁰⁵		connection with the lift ¹⁰⁷
Policy primacy (i.e., who has primary responsibility for safety, availability, etc.)	NYC Department of Buildings, Elevator Unit (Municipal)	BC Safety Authority (Provincial)	Chicago Department of Buildings, Elevator Bureau (Municipal)	UK Health and Safety Executive (HSE) (National)	Electrical & Mechanical Services Department (National)	Building & Construction Authority (National)
National legislation / regulations and focus (e.g., safety, consumer experience)	ASME A17.1 Safety Code for Elevators and Escalators	National Building Code of Canada, A17.1/CSA B44	ASME A17.1 Safety Code for Elevators and Escalators	LOLER & PUWER	Lifts & Escalators Ordinance, & Lifts & Escalators General & Fee Regulation	Building Maintenance & Strata Management Act, Lift & Building Maintenance Regulations
State / Provincial legislation / regulations and focus (e.g., safety, consumer experience)	New York State Building Code, Elevator Code	Safety Standards Act, Safety Standards General Regulation, & Elevating Devices Safety Regulation	Elevator Safety and Regulation Act	N/A	N/A	N/A

Municipal legislation / regulations and focus (e.g., safety, consumer experience)	New York City Building Code, Elevator Code	City of Vancouver By-laws	City of Chicago Municipal Code, Elevator Code	N/A	N/A	N/A
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¹⁰⁵ Consumer Protection Health and Safety, The Lifts Regulations 2016. (http://www.legislation.gov.uk/uksi/2016/1093/pdfs/uksi_20161093_en.pdf)

¹⁰⁷ Building Maintenance and Strata Management (Lift and Building Maintenance) Regulations 2016. (<http://statutes.agc.gov.sg/aol/home.w3p>)

Research Topic	New York City	Vancouver	Chicago	Hong Kong
# of elevators operating	~85,000 ¹⁰⁸	N/A	N/A	~70,000 ¹¹⁰
Building requirements (e.g., how many storeys before an elevator is required)	In buildings five storeys in height or more, at least one elevator shall provide access to all floors ¹¹²	At least one elevator required in buildings five storeys in height or more ¹¹³	At least one elevator required in buildings five storeys in height or more ¹¹⁴	N/A
Responsibility for enforcing building requirements	NYC Department of Buildings	City of Vancouver	Chicago Department of Buildings	Buildings Department

¹⁰⁸ NYC DOB. New York City Lift & Escalator Regulatory Landscape. (http://www1.nyc.gov/assets/buildings/pdf/singapore_presentation.pdf)

¹⁰⁹ Lift and Escalator Industry Association website. (<https://www.leia.co.uk/>)

¹¹⁰ University of Hong Kong, Types of Lifts. (<https://www.eee.hku.hk/~work6000/LA%20types%20of%20lifts.pdf>)

¹¹¹ Building and Construction Authority website. (<https://www.bca.gov.sg/LiftSafety/lift.html>)

¹¹² NYC Building Code. (<https://www1.nyc.gov/site/buildings/codes/2014-construction-codes.page#bldgs>)

¹¹³ BC Office of Housing and Construction Standards, Building Access Handbook. (http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/construction-industry/building-codes-and-standards/guides/2014_building_access_handbook.pdf)

¹¹⁴ Chicago Building Code. (http://www.amlegal.com/codes/client/chicago_il/)

¹¹⁵ The Building Regulations 2010, Approved Document M. (http://www.mcplanandsiteservices.co.uk/assets/br_pdf_ad_m1_2015.pdf)

¹¹⁶ BCA Code on Accessibility in the Built Environment. (https://www.bca.gov.sg/BarrierFree/others/ACCESSIBILITY_CODE_2013.pdf)

Research Topic	New York City	Vancouver	Chicago	London	Hong Kong	Singapore
Fire requirements	In buildings five storeys in height or more, at least one elevator shall be provided for Fire Department emergency access to all floors. ¹¹⁷	In “high buildings” at least one elevator must be provided for use by firefighters. It must be capable of reaching the top floor from the designated (recall) floor within 1 min. and must serve every building floor above the designated floor level. ¹¹⁸	At least one elevator is to be provided for fire department emergency access to all floors of a high-rise building. ¹¹⁹	Flats over 18m in height should be provided with a fire-fighting shaft, consisting of a fire-fighting stairway and a fire main located in the stairway, and a fire-fighting lift. The fire-fighting lift can, in blocks of flats, open into the common corridor giving access to the flat entrance doors, providing the lift doors are no more than 7.5m from the door to the stairway. ¹²⁰	Fireman’s lifts should be provided to enable firefighters to reach any floor that may be on fire in the building without having to traverse more than two floors and should be arranged in such a way that: (a) in the case of a single fireman’s lift, it serves at least the alternate floors; (b) in the case of multiple fireman’s lifts within a common liftwell,	In any building or part thereof, in which the habitable height exceeds 24m, or the depth of the basement is more than 9m below the average ground level, there shall be provided at least two fire lifts. A fire lift shall have access to every habitable floor above or below the designated floor and shall be adjacent and accessible to an exit staircase and be approached by a firefighting

¹¹⁷ NYC Building Code

¹¹⁸ BC Building Code

¹¹⁹ Chicago Building Code

¹²⁰ Fire Safety: Approved Document B

Research Topic	New York City	Vancouver	Chicago	London	Hong Kong	Singapore
					the lifts may serve different zones of the building provided that the zones to be served are clearly indicated; ¹²¹	lobby at each storey. ¹²²
Responsibility for enforcing fire requirements	NYC Department of Buildings	City of Vancouver	Chicago Department of Buildings	The City of London Corporation	Buildings Department	Singapore Civil Defence Force

¹²¹ Hong Kong Buildings Department, Code of Practice for Fire Safety in Buildings (2011)

¹²² Singapore Civil Defence Force, Fire Code (2013)

Appendix C – Stakeholder Organizations Consulted

1. Advocacy Centre for Tenants Ontario
2. Association of Condominium Managers of Ontario
3. Bentall Kennedy
4. BOMA
5. Building Industry and Land Development Association (BILD)
6. Canadian Condominium Institute
7. Canadian Healthcare Engineering Society
8. City of Toronto
9. TSSA Consumers Advisory Council
10. Consumers Association of Canada
11. Consumers Council of Canada
12. Del Property Management
13. Delta Elevator Co Ltd.
14. Effort Trust Company
15. Elevator One, Inc.
16. Federation of Metro Tenants Associations
17. Federation of Rental Housing Providers of Ontario
18. Greater Toronto Apartment Association
19. Industry Canada / Competition Bureau
20. International Union of Elevator Constructors
21. KJA Consultants, Inc.
22. KONE Inc.
23. Large Municipalities Chief Building Officials
24. Ministry of Advanced Education and Skills Development
25. Mattamy
26. Ministry of Community Safety & Correctional Services / Office of the Fire Marshal and Emergency Management
27. Ministry of Economic Development & Growth / Accessibility Directorate of Ontario
28. Ministry of Government & Consumer Services
29. Ministry of Health & Long-Term Care / Long-Term Care Homes
30. Ministry of Housing
31. Ministry of Municipal Affairs
32. Ministry of Seniors Affairs / Ontario Seniors' Secretariat
33. Minto Group Inc.
34. MPP Han Dong
35. National Elevator and Escalator Association
36. National Elevator Industry, Inc.
37. Ontario Building Officials Association
38. Ontario Home Builders' Association
39. Ontario Long-Term Care Association
40. Ontario Retirement Communities
41. Ontario Society of Professional Engineers
42. Otis Canada Inc.
43. Oxford Properties Group
44. Park Property Management
45. Preston Group
46. Quality Allied Elevator
47. RealStar
48. Retirement Home Regulatory Authority
49. Schindler Elevator Corp.
50. Technical Standards and Safety Authority
51. ThyssenKrupp Elevator (Canada) Ltd.
52. Toronto Area Chief Building Officials
53. Toronto Community Housing Corporation
54. Toronto Fire Services
55. Toronto Transit Commission
56. True Canadian Elevator Maintenance Company Ltd., CECA
57. TSSA Consumers Advisory Council
58. York Region District School Board

Appendix D – Risk Assessment Methodology

Broadly speaking, the issue of elevator unavailability is perceived to have impacts on public safety and consumer satisfaction (protection). Srikanth Mangalam of PRISM Institute and working on behalf of the Deloitte team, undertook a risk assessment study in order to scientifically characterizing the issue of availability in terms of its impact on public safety. The assessment would help determine the significance and the causal factors associated with the level of risk. Key findings from the report are included in this study and are considered as one of various other inputs into decision-making process.

1. Assumptions and Baseline Definitions

The risk assessment methodology and approach is based on the following key assumptions, limitations, and scientific postulates:

- Availability is characterized based on definition provided in international technical standards on dependability (IEC TC 56);
- Risk is used to characterize the significance and impact of non-availability. For the purposes of this study, the impact of non-availability is assumed to cause to harm to the public;
- Estimation of risk can also be characterized in appropriate units and used to benchmark against internationally adopted acceptable levels of risk; however, such acceptable levels of risk are not described in this report;
- The scientific definition of risk as a combination of probability of harm resulting from non-availability and the severity of the consequences of harm is used (ISO Guide 51);
- Sources of evidence may include direct evidence (incident reports, inspection results, sample collection, readings and measurements etc.), indirect evidence (external sources of data), empirical evidence (experimental data, research), expert knowledge, Local knowledge, and inference (similar technologies, maintenance requirements etc.);
- Variability and uncertainty in evidence need to be treated or recognized, at a minimum, when applying the methodology
- While timeliness has been identified as one of the factors influencing availability, this report does not address this factor.

Definitions for dependability, including one for availability and others that relate to it, can be found online in the IEC Electropedia, and specifically under IEC 192 Dependability standard.

As per the standards, the following definitions are relevant:

1. Dependability: the ability of an item to perform as and when required. Dependability includes availability, reliability, recoverability, maintainability, and maintenance support performance, and, in some cases, other characteristics such as durability, safety and security. Dependability is used as a collective term for the time-related quality characteristics of an item.
2. Availability: the combined characteristics of the reliability, recoverability, and maintainability of the item, and the maintenance support performance.
3. Reliability: ability to perform as required, without failure, for a given time interval, under given conditions such as: mode of operation, stress levels, environmental conditions, and maintenance.
4. Recoverability: ability to recover from a failure, without corrective maintenance. The ability to recover may or may not require external actions.
5. Maintainability: ability to be retained in, or restored to a state to perform as required, under given conditions of use and maintenance such as: location for maintenance, accessibility, maintenance procedures and maintenance resources.
6. Supportability: effectiveness of an organization in respect of maintenance support.

2. Methodology

A quantitative risk assessment approach using a combination of fault tree-event tree techniques (as described in the IEC 61025 Standard) was used for the purposes of determining the extent of availability of elevators in Ontario and, more importantly the

significance of non-availability, the risk of non-availability (as a function of the reliability and maintainability) of elevators. The risk of non-availability was described in terms of potential health impacts to residents and measured as chance of Fatality (or Life Threatening) Equivalents/year and compared with individual risk acceptability criteria of 1 in a million chance of fatality/year.

A Fault Tree Analysis approach is a deductive technique that uses a graphical representation of the effects of failures on technical/technological systems. Boolean gates (And/OR) are used to represent the logical interrelationships between events that would lead to the failures. A fault tree typically involves identifying a top event that represents an undesired state or a state of failure which could result in undesirable consequences. Fault tree analysis involves the determination of all possible chains of basic and intermediate events that may cause the top event to occur. Individual frequencies obtained through data analysis or expert judgment are assigned to the basic and intermediate events and combined using Boolean logic to determine the top event frequencies.

Consequence modeling was carried out for identifying and evaluating the sequence of events in a potential accident scenario/s (such as life threatening events, injuries or fatalities) following the occurrence of an initiating event (typically the top event obtained through an FTA). Conditional probabilities are assigned to the events leading to the accident scenario using data analysis and/or expert judgment to ultimately quantify the probability of consequence impacts. Risk is subsequently calculated as the product of the top event frequency and the probability of consequence impacts associated with the top event.

Risk in the context of elevator unavailability can be estimated as follows:

$$RRRRRRRR = EE' (* EE* * EE+ * FF. (1)$$

where,

EAD = Frequency of Elevator Unavailability (Top Event) (Elevator Unavailability days/device-year)

Em= Chance of Emergency (Building or Resident) when Elevators are not available

Ex= Chance of individual exposure to an emergency (Building or Resident), assumed to be equal across individual building populations

Fe Chance of Incident (fatality) given exposure (fully unavailable or partially unavailable elevators)

Risk= Chance of FE/year

The risk assessment approach undertaken to determine the risk of elevator non-availability involved the following steps:

1. TSSA Data Analysis
2. Expert Group Formation
3. FTA Facilitation
4. Consequence Modeling
5. Risk Characterization and Evaluation

The inputs, their sources and frequencies associated with the basic events are shown in Figure below. The intermediate events are calculated using Boolean logic based on the base event frequencies. An inventory size of 22,193 elevators was assumed while calculating frequencies. Note that this estimate includes hospitals. The focus of the Elevator Availability Study more broadly was on residential and institutional buildings excluding hospitals, an inventory size of approximately 19,900 elevators. I.

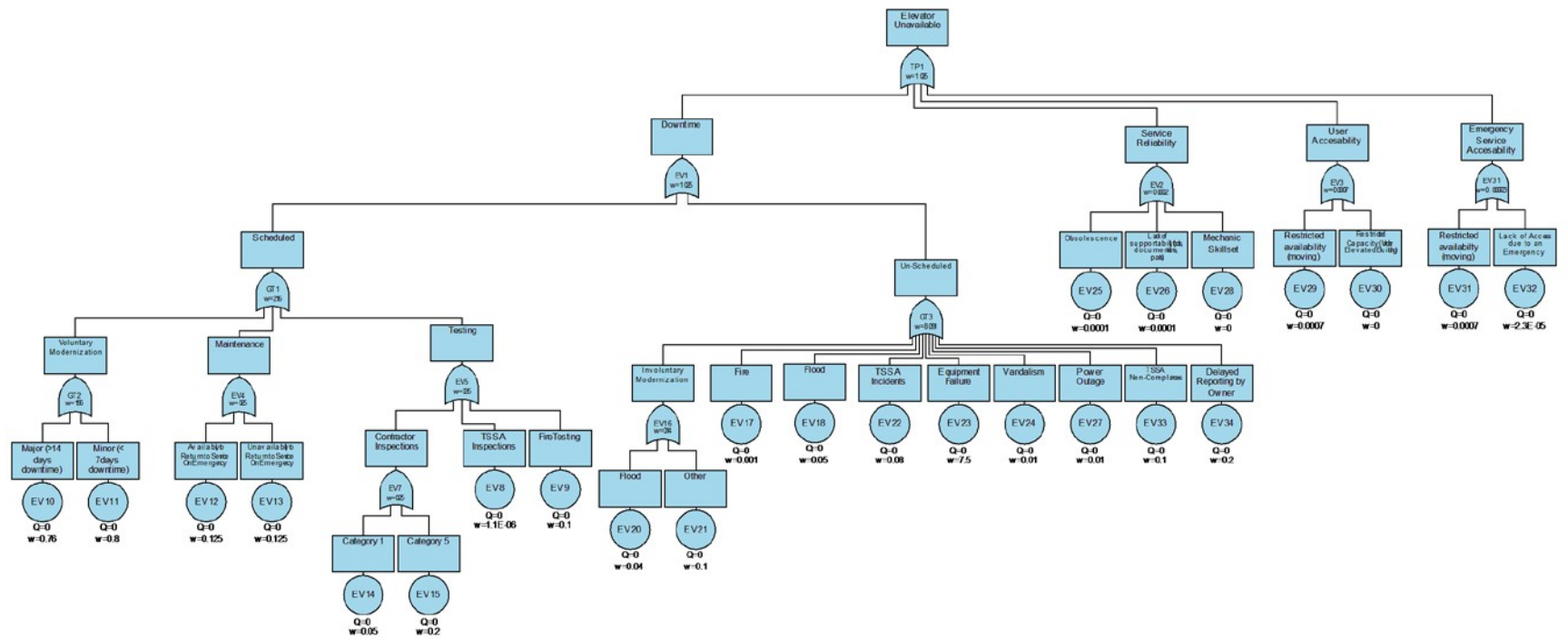


Figure 8 - Fault Tree Analysis to determine frequency of elevator unavailability