Mark1 Startup Application

Technical

In 3 sentences or less, explain your technology and the core innovation. *

[Find a linkable version of this application at https://milpitasprt.com/wp-content/uploads/Mark1-Application.pdf]

LoopWorks is creating an on-demand, non-stop from origin to destination, all-electric Personal Rapid Transit (PRT) system that will mitigate congestion, accessibility issues, and carbon emissions. Our demonstration project will showcase a new transit mode that will attract the public and operate at costs far less per passenger-mile than other public transit options. The core innovation is combining small, automated cabs with elevated guideways and off-line stations.

Describe the total potential CO2e equivalent reduction with the adoption of your technology and a brief description of your calculation methodology. If possible, provide supporting documentation. *

For this question, we use a shorthand "unit" of 100 square miles of PRT service. LoopWorks estimates a total addressable market (TAM) of $1T, or 150 units of coverage, making PRT a high-impact solution with gigaton-scale drawdown potential in a global market. The highly efficient, non-stop trips provided by PRT use about 90% less energy than cars. Using electric-motive force rather than fossil fuel combustion to move cabs allows use of increasingly common carbon-free, renewable energy.

Per unit of PRT, an estimate of 352,000 tons of CO_2 emissions abated each year is derived from the following. The dual-loop PRT system will serve an area of 1.4 sq-miles, which is 10% of the entire 14.2 square-miles encompassed by Milpitas city limits. Although population density is higher than average in the PRT area, a conservative 10% of the entire city population will be served. During 2019, 26,306,367 gallons of gasoline were sold in Milpitas, so roughly 10%, or 2,630,636 gallons, were bought and burned by Metro Area residents. If just 20% of their gas-powered trips switched to PRT and other clean alternatives, then PRT will prevent the burning of 526,126 gallons per year – or 4930 tons of CO_2 emissions each year (18.74 lbs/gallon X 526,126 gal. X ton/2000 lbs). Similar factors applied to a 100 sq-mi area – a single unit – would be 71.4 times as much, or 352,000 tons of CO_2 emissions each year.

Second Order Effects
Most trips in Milpitas currently utilize a car. Studies show that the synergy of PRT with other existing transportation options will dramatically increase transit ridership. (See https://milpitasprt.com/technology/service-levels/#share) These transit trips that previously would be taken by car can be counted toward PRT's reduction in CO_2 emissions. A PRT system also opens up possibilities for moving freight, recyclable materials, and garbage – leading to further large reductions in CO_2 emissions.

PRT reduces resource consumption in a world of resource limits. Every vehicle, whether a car or a PRT cab, has embedded carbon that was required to manufacture it. Rather than electrify privately-owned cars that sit idle 95% of the time, PRT electrifies community-shared transit cabs that are in frequent use throughout the day. By reducing the need for personal cars, fewer will be owned which will reduce the concomitant embedded carbon.

Upload CO2e impact calculations and methodology here.

If the above description is insufficient, please suggest a CO2e impact calculator to produce more exact numbers.

Based on this scale, what TRL level are you? *

TRL 6 – Engineering/pilot – scale, similar (prototypical) system validation in relevant environment

The prototype ITNS design that LoopWorks will employ in the Milpitas PRT project won competitions in Chicago, SeaTac, and Cincinnati. In 2003, the prototype materialized with the construction of a fully automatic vehicle for a budget of only $600,000 and 6 months from the initial order-to-proceed until operation. The vehicle operated as designed on a 60-ft section of covered-steel-truss guideway at the 2003 Minnesota State Fair 12 hours per day for 12 days with no failures. Thus, the prototype design is clear and detailed at https://milpitasprt.com/wp-content/uploads/technical-specifications.pdf

Based on that 2003 demonstration, the technology readiness level is "system prototype demonstration in an operational environment." The ITNS design awaits a specific project employing it, such as the Milpitas PRT project estimated to cost $6M for all pre-construction engineering and planning. As a Phase 1 project, initial contacts with all stakeholders will accompany the review by a trustworthy construction company of the basic design and implementation plan to ensure both are viable.

For the technology you want to scale, check this box if you have a commissioned running pilot.

[not checked]

What is the capacity of your current pilot, and what is the capacity of your proposed project (whether demonstration or first-of-a-kind)? Please define using whatever metric is most relevant to your scale up (e.g., L of bioreactor capacity or tons of output produced or # of additional modular units). *

Page 36 of the ITNS Business Plan (https://milpitasprt.com/wp-content/uploads/Business_Plan_2019.pdf) provides numbers used for this estimate. An average trip length of 1.6 miles for each of 540 Passenger-Trips/peak-hour yields 864 passenger-miles during peak hours. LoopWorks expects to deploy 8 cabs for each podcar stop, resulting in a fleet size of 96 cabs. Thus the average cab will provide fewer than 10 passenger-miles of service during peak hours. That suggests that cabs traveling at 30 mph average speeds during that service will be idle over half the time during peak hours.

What feedstocks does your project require once operational? *

O&M will require electricity and people. The simple ITNS design and use of off-the-shelf components will keep maintenance (people and parts) costs down. The electricity supply for the project comes from SVCE which is already carbon-free, and electricity will generally become more sustainable over time across the country. As with Solar Skyways and the Spartan Superway, photovoltaic panels could be added to this system to create the possibility of a turnkey transit solution that does not depend upon a local, reliable grid.

Do you require electricity from the grid? If so, how much per unit of output or product, and what is your peak power (capacity) requirements in MW? *

While the potential to add photovoltaic panels to make the system self-sustaining will be explored in the engineering portion of the Milpitas PRT Demonstration Project, LoopWorks expects to get its primary power from Silicon Valley Clean Energy delivered through the PG&E grid.

As shown in this chart, kW-hr/pass-mile is used to rank efficiency for various transit modes. Likewise does the ENERGY USE bar chart on page 23 of the ITNS Business Plan. There, a list of various transit modes shows PRT near the bottom with 0.6 kW-hr/pass-mile, and Light Rail at 3.0 kW-hr/pass-mile. PRT company Glydways estimates an average of 0.18 kW-hr/mile for their cabs.

PRT's low energy consumption results primarily from the highly efficient, non-stop trips that use about 90% less energy than cars. Additional factors include 1) small, light-weight aerodynamic cabs and 2) high-pressure rubber tires running on smooth steel tracks. By using electric linear induction motors to move cabs rather than fossil-fueled combustion engines, PRT can use increasingly common carbon-free, renewable energy.

*Using the 0.6 kW-hr/pass-mile figure, combined with an average trip length of 1.6 miles, and 540 Passenger-Trips/peak hr/sq-mi (from page 36 of the ITNS Business Plan), we get estimate 518.4 kW per sq-mi, or **15840 kW per "unit" of 100 square-miles during peak hours**. (1.6 miles/trip X 0.6 kW-hr/pass-mile X 540 trips/sq-mi X 100 sq-mi = 15840 kW)*

What are the outputs of your technology? Please include the core product, any byproducts and waste streams. *

While the primary output of PRT technology is convenient and carbon-free trips, maintaining the system with replacement parts and cleaning the cabs will generate some small waste streams.

Has your technology been deployed previously at full commercial scale? If yes, please describe why previous deployments may not be considered a true first-of-a-kind commercialization. *

While full commercial scale deployment that covers 10 or more square-miles has not been done, a group rapid transit (GRT) system that operates well was built at Mogantown University in West Virginia. After nearly 50 years of operation, the system boasts 80 million passenger-miles without serious injury.

That deployment, and other PRT systems in use, may not be considered a true first-of-a-kind commercialization due to their high cost, narrow application, and lack of growth. As outlined on page 36 of the ITNS Business Plan, a nine square-mile transit service area is expected to provide a network large enough to attract ridership sufficient to pay for capital costs and operating costs. While the Milpitas PRT Demonstration Project will only serve 1.4 square-miles, the cost and ridership figures obtained from it will give us a clear idea whether estimates in the ITNS Business Plan are roughly accurate.

Check this box if you have granted patents, and please upload.

[box not checked]

Upload patents here.

On page 14 of the LoopWorks Business Plan are listed the 5 basic patents which were granted to the University of Minnesota on the system invented by Dr. Anderson. Although LoopWorks believes all 5 required basic patents are now available to the public, other patentable ideas will be sought and secured as part of the development process. Doing so will prevent for-profit companies from claiming them, and then controlling or preventing their use in other projects. LoopWorks will own the detailed plans and specifications needed to build the Milpitas PRT System, and will make them easily available on-line to the public to encourage others to build their own systems.

Check this box if you have completed a Techno-Economic Analysis, and please upload.

[box not checked]

Upload TEA here.

[none]

Commercial

What is your business model? *

[Find a linkable version of this application at https://milpitasprt.com/wp-content/uploads/Mark1-Application.pdf]

LoopWorks will deliver service consistent with its Bylaws which outlines a unique path to success and sustainability. While our model is attractive for an initial demonstration project, other models are better-suited and more likely to be employed in the transit industry. Three business models for

Personal Rapid Transit (PRT) technology are the LoopWorks model, the public transit model, and the for-profit model.

LoopWorks Model

PRT is a high value, high impact innovation that should attract the CapEx funding for the Milpitas demonstration project. LoopWorks is incorporated as a taxable non-profit under Nonprofit Mutual Benefit Corporation Law. As such, it is well positioned to demonstrate the viability of PRT by creating a transit commons, but not for generating high rates of return on investment.

As a first-of-its-kind demonstration project, LoopWorks expects to obtain gratis/free funding from foundations, investment groups, and/or government agencies (federal/state) for designing and building the initial dual-loop system. Similarly, LoopWorks plans to grow the system to serve most of Milpitas using grant funding from entities interested in what results follow from growing a small system. By funding capital expenses with grant money, LoopWorks helps ensure its financial viability by avoiding the burden of repaying both the capital costs and the interest on debt that would otherwise be required.

Once built, LoopWorks must cover the O&M costs. Annual O&M in the mass transit industry runs between 3% and 5% of total capital costs. Because PRT is light-weight (low-cost) and automated, the ITNS Business Plan estimates O&M costs at 3%. However, a case can be made that O&M costs could be as low as 1%. Such dramatically reduced O&M costs suggests that modest fares could cover them. To ensure affordable fares, LoopWorks will also investigate alternative revenue streams to supplement or replace fares.

Public Transit Model

LoopWorks' Bylaws requires it to "strive to charge transit rates that are either comparable or less than rates for transit provided by the area's predominant public transit services." Given low capital and O&M costs, that could be easily accomplished. Thus, transit agencies may find that PRT systems can supplement or supplant existing transit services for less cost than current technologies. For example, transit operations in Santa Clara County provided by the Valley Transportation Authority (VTA) require an 85% subsidy from County taxpayers. Only 15% of costs are covered by fares. So, a PRT system that only requires a 50% subsidy would save the agency money while providing improved service.

For-Profit Model

Our Vision: The LoopWorks PRT project inspires rapid adoption of advanced transit that dramatically reduces transportation sector emissions. To manifest such a vision requires support from our capitalist system in the form of investments in PRT systems with the goal of turning a profit. That is exactly what Glydways and its partners intend with their PRT connection between the San Jose Airport and the major intermodal transit center at Diridon Caltrain station. Financial partner Plenary Americas is a "leading long-term investor, developer and manager of public and private infrastructure, specializing in public-private partnerships, local development and asset management." Glydways expects to turn a profit - even with vehicles weighing 2,000 lbs. each.

Cabs designed by ITNS weigh roughly half as much, so guideway and total system costs are expected to be substantially lower than Glydways' offering. As outlined on page 36 of the ITNS Business Plan, a transit service area of nine square-miles seems sufficient to cover capital and operating costs. That size network can attract enough ridership that modest fares can yield a profit. Because that potential for profitability could be corroborated by data from the Milpitas demonstration project, a large for-profit entity could justify investing simply to get the data.

Describe your total addressable market ($USD) and a brief description of your calculation methodology. *

Successful completion of this $60M R&D project will yield CapEx numbers to inform transit agencies and for-profit investors. Promising results could kick-start a $1T advanced transit industry that employs replication, scaling, and network effects to rapidly grow opportunities worldwide.

Primary target markets are metropolitan areas needing improved transit due to congestion, pollution, or legal requirements to reduce CO_2 emissions. According to PRT company Glydways, about 5,000 cities on Earth need - but only 178 cities have - mass transit systems. PRT can provide 24/7 service to an area of 10 square miles through 80 neighborhood podcar stops for under $1B. By contrast, the local transit agency plans to spend $12B on 4 commuter rail stations along a 6-mile corridor (https://vtabart.org/).

PRT can grow locally (as planned for Milpitas), replicate virally, and scale to serve large metropolitan areas like San José. A total addressable market (TAM) of $1T is estimated from a need for 150 PRT systems that each cost about $7B and serve 100 square-miles (https://milpitasprt.com/wp-content/uploads/BART-PRT-flyer.pdf). Three such areas exist in the San Francisco Bay Area.

Secondary markets could arise from PRT's potential to challenge commuter rail service. The San Francisco Bay Area's commuter rail service (BART) can achieve speeds of 80 mph, but its average operating speed is 40 mph due to frequent stops. Without stops, PRT can provide comparable end-to-end speeds with 40 mph top speeds. Additionally, the ITNS PRT design is capable of speeds exceeding 80 mph, and thus able to provide faster service than BART for a small fraction of the cost.

How do your projected unit economics compare to competitive products currently in the market?

The economics of mass transit systems is well-established – they require subsidies. Whether bus, light rail, or commuter rail, all except a few special cases (serving niche markets) require help from taxpayers to maintain (much less grow) transit service. For example, transit operations in Santa Clara County provided by the Valley Transportation Authority (VTA) require an 85% subsidy from County taxpayers. Only 15% of costs are covered by fares. So, a PRT system that only requires a 50% subsidy while improving service would be very competitive to existing mass transit technologies. Worse still for mass transit is that PRT companies anticipate a profit. On a level playing field, PRT technologies would naturally spread rapidly.

Ridership: After decades of transit agency investments to grow ridership, not much has changed. During those years, a dozen studies concluded that public transit ridership would grow by 100%, 200%, or more when Personal Rapid Transit (PRT) is added to the existing transit mix. Attracting ridership to transit normally requires headways of 10 minutes or less. To achieve that, VTA would need to double the number of buses on the road at a time when the farebox only covers 15% of operating costs. From where will the money come?

The economics of driverless vehicles are being discovered now. LoopWorks anticipates their success and growth. Due to exciting new synergies between PRT and driverless technologies, rather than a competitor, driverless cars are more likely to complement PRT. Here's why.

Cost: While the up-front costs of PRT are higher than fielding a fleet of driverless vehicles, the operating costs are much lower for PRT due to more efficient use of fuel, far fewer moving parts, and separation from traffic hazards. The return on investment (ROI) is the real measure. After the Milpitas demonstration project is completed, we will have better data with which to estimate ROI.

Congestion: While driverless vehicles can offer service similar to PRT in getting people to/from places using a network of streets, they cannot do it quickly when those streets are congested. And, their very presence adds to the congestion: 1) latent demand from people unable to drive will increase car trips, and 2) dead-heading (moving without a passenger) will increase car trips. Here in Milpitas, our congestion is so bad and barriers so many, that using PRT to rise above it all makes sense - even at a cost of $60M. Our BART/LRT/bus transit hub lies at the intersection of 2 major roadways (6 & 8 lanes), so PRT will provide a quick ride to/from the hub regardless of congestion. PRT can also bridge 6 barriers (2 major roads, 2 rail lines, and 2 creeks) that make walking and rolling challenging.

While driverless cars are expected on Milpitas roads within a few years, the fundamental technology of roads and cars has limits that are already being stressed by the existing demand - and showing up as congestion. While driverless technology merits support for various reasons, their role in congested areas may be most useful by supporting PRT with rides to and from podcar stops – just as PRT will support the transportation options at the Milpitas Transit Hub by bringing people to and from there.

Asset Utilization: Already-congested areas are the best places to install PRT because it mitigates the congestion (by removing some demand) while augmenting existing transit. In fact, studies indicate that PRT will dramatically increase use of transit generally when added to existing transit options. (https://milpitasprt.com/technology/service-levels/#share) Our society has already sunk a lot of money into commuter rail, light rail, and buses. Increased utilization of that investment makes economic and environmental sense. Driverless cars are more likely to be used exclusively from origin to destination rather than supporting existing transit.

What is your key differentiation from competitors or alternatives? How does your solution compare? * **-** Please name at least three competitors (they don't need to be exact analogs).

During the Podcar City conference in December, 2023, several PRT companies provided system information. A comparison of costs per one-way mile of elevated guideway ranged from $5M to $50M. (See https://southbaypa.org/prt/#costs.) LoopWorks uses an estimate of $15M/guideway-mile (one-way) for ITNS technology, placing it in the lower half of PRT cost estimates. One characteristic that makes LoopWorks stand out is the non-proprietary technology that is used, making it immediately available for replication without the need for patent or franchise negotiations.

Swyft Cities
At $5M/mile, Swyft Cities technology is clearly the least expensive. They achieve this cost savings by using cables instead of guideways. As at ski resorts, the passengers are suspended below the cable. Unlike ski lifts, the PRT cable does not more. Instead, the vehicle's bogie contains proprietary technology to grab hold of the cable and move itself (and its payload) along at speeds up to 30 mph.

Although the technology allows for change in direction at each support post, all other parts of the route are straight lines. This limits the flexibility of routing that other PRT technologies offer.

Cable technology inherently has two other limitations that will restrict their use in storm conditions - wind and ice. As a suspended system, the cabs are more affected by cross winds than ITNS' supported cabs, possibly limiting their use during windy conditions. Their exposed cables may develop a coating of ice in cold weather that may affect performance. Impacts of both wind and ice is yet to be determined. The ITNS design minimizes guideway size to limit stresses from wind, and encloses the guideway so icing is avoided.

Solar Skyways

Solar Skyways and Spartan Superway are collaborating on a suspended design that uses photovoltaics to generate more energy than the PRT system consumes. While a major selling feature for developing countries without reliable local grid service, solarizing adds to the initial cost. Also, because the PV panels are designed to be above the guideway, they add engineering challenges. As a suspended system, the supports are already taller to ensure the required 16' minimum height going over streets. To that height must be added space for the PV panels. Now comes the big challenge – wind! By putting what is effectively a wind sail that high up creates large and leveraged stresses on the supporting structure. How this design plays out in real applications is unknown.

Glydways

Like ULTra technology at Heathrow Airport, the Glydways design uses roadway-like guideways. Glydways is a private, for profit company using a proprietary design and dedicate guideways that are often at grade level using public right-of-ways. ULTra PRT, which was development at Bristol University in the United Kingdom, is now moving people and their luggage from parking lots into the terminals of Heathrow International Airport.

Both systems use a wide guideway, which has a large visual impact and is a snow-catcher in winter months. Both systems have the following characteristics which will limit use to fair weather, low-speed, low capacity applications:

- *Rotary motor propulsion and wheel braking limit minimum headways to about 6 seconds.*
- *On-board battery power limits both speed and range while adding weight.*

The design of autonomous cabs suggests future plans for them to exit the guideway and move around on city streets. While an attractive sales point for investors, the resulting downsides of added weight, complexity, and cost are substantial.

Modutram

Of these 4 competitors, Modutram is the most similar in design and cost to the ITNS flavor used by LoopWorks. Both are supported rather than suspended, and both use rubber tires on steel rails supported by trusses.

The critical difference between them is propulsion: Modutram uses rotary motor propulsion and wheel braking (like cars), while ITNS uses linear induction motors (LIM). As mentioned about Glydways, rotary propulsion impacts minimum headway due to control issues, especially when steel rails get wet or icy. That's not a problem for ITNS and its LIM-powered cabs. LIMs provide far superior control, as demonstrated at amusement parks, especially in rides that go straight up and stop.

Find additional information see Competing PRT Technologies.

Please list key strategic partners and how you work with them. *

The LoopWorks PRT system has two distinct phases: design/construction and operation/maintenance (O&M). LoopWorks will contract out the design/construction work and then become the company that performs on-going O&M. Our team has the business experience, local connections, and governance structure to ensure this community-based business operates well once service begins and full-time employees are hired.

In the design/construction phase, LoopWorks will employ the capabilities of a design/build company. Safety and security will be largely handled by the California Public Utilities Commission and City of Milpitas Planning Department. At this point in time, LoopWorks is considering Devcon Construction as the primary contractor for both design work and construction. (Devcon Construction, 690 Gibraltar Drive, Milpitas, CA 95035, 408-942-8200, http://devcon-const.com/)

If early meetings with Devcon surface any serious issues, we can also utilize the engineering and construction management services of Rudolph and Sletten. With over five decades of building experience, Rudolph and Sletten has literally built the foundation of California's industries – including Monterey Bay Aquarium and Stanford's Keck Science Building. They have 6 regional offices in California, and proclaim: Let's Build technically challenging projects, with uncompromising quality, faster with innovation. (Rudolph and Sletten , 2 Circle Star Way 4th Floor, San Carlos, CA 94070 https://www.rsconstruction.com/)

How many customers do you have today? How many in your pipeline? *

As noted in the Business Model section, LoopWorks has only 1 customer, the City of Milpitas collectively including its residents and businesses.

Do you have any executed offtake agreements, LOIs or MOUs? Please describe. *

Although not accepted/executed, we have offered an MOU to the City of Milpitas that provides a no-risk opportunity to cooperate with LoopWorks on the Milpitas demonstration project.

Project

Please provide a narrative of the project you want to co-develop with Mark1. *

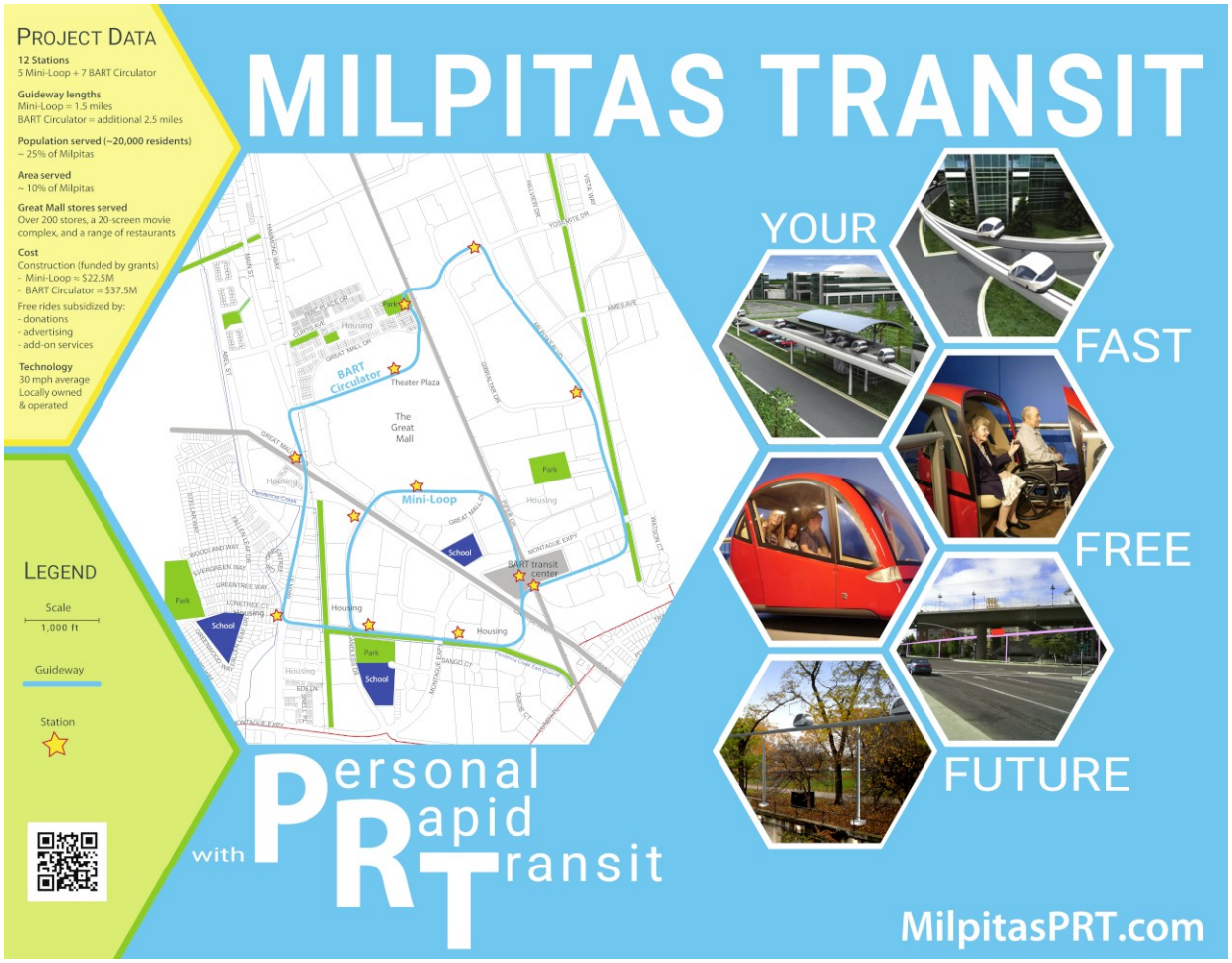
[Find a linkable version of this application at https://milpitasprt.com/wp-content/uploads/Mark1-Application.pdf]

In Milpitas, like many cities across America, walking and biking are discouraged by physical barriers and high traffic volumes that prevent people from easily moving around town without a car. That's especially true in the Metro Area of Milpitas where barriers include 2 major roads (Montague

Expressway and Capitol Ave/Great Mall Parkway), 2 rail lines (Union Pacific and BART), and 2 creeks. Even driving around the area is sometimes difficult due to heavy congestion in the Metro Area. In the past decade, 7000 housing units were built there; another 7000 are expected over the next decade.

In 2020, the Milpitas Transit Center became fully operational by providing access to commuter rail (BART), light rail (LRT), a bus hub, and Uber/Lyft along with provisions for cyclists and pedestrians. Unfortunately, various barriers and already-bad traffic congestion discourage access to that cornucopia of transportation options. Congestion in the Milpitas Metro Area will worsen as the BART transit hub comes to serve the projected 25,000 daily riders (12,000 daily BART riders plus a similar number for all other transit hub options). Expected soon are driverless vehicles that will further increase congestion due to use by people currently unable to drive and dead-heading (driving around empty to fetch the next rider). The opening of the Transit Center combined with a rapidly-growing population means the need for bike/pedestrian crossings of Metro Area barriers is also growing rapidly.

As shown in the project poster at https://milpitasprt.com/wp-content/uploads/posterPRT-2022-w-QR.pdf, an initial dual-loop PRT system is proposed to include 4 miles of guideway connecting 12 stations for a cost of $60M (4 miles x $15M/mile), or about the cost of Milpitas City Hall in inflation-adjusted dollars. Doing so will remove the need for 3 bike/pedestrian barrier crossings.



This project will require easements from many property owners, including the City of Milpitas. Three of the five City Council members have indicated their interest in further discussions if some outside money appears. Mark1 could get that financial ball rolling. Final design, engineering, and permitting is estimated at $6M. While that prepares the project for construction, it also will deliver a big chunk of the primary payoff – data! Much more will be known about costs, impacts, benefits, and return on investment.

Viewing this project through a research and development (R&D) lens is appropriate. Already, a list of research opportunities and development reports are identified in the LoopWorks Business Plan (https://milpitasprt.com/wp-content/uploads/business-plan.pdf). Specifically, the section entitled *Performance Reports – The Big Payoff* (pages 65-69) addresses Data to Collect and Share, Vehicle Performance and Efficiency, 3rd Party Data, along with other valuable data and metrics.

One specific metric important to monitor is public transit ridership. Based on many studies, PRT will spark a dramatic increase. As shown here (https://milpitasprt.com/technology/service-levels/#share), PRT service is expected to increase transit ridership by factors 2X to 10X. Such far higher use of existing public transit resources would create ripple effects to observe.

Do you define the project you'd like to work on with Mark1 as a demonstration facility or a first full-scale commercial facility? *

The proposed dual-loop PRT system is a demonstration project that, with time and resources, could grow into a full-scale commercial (meaning profitable) facility serving 10 square miles. Because PRT is scalable, coverage could be added incrementally to the original 1.4 square-mile service area. Due to the network effect, each additional podcar stop not only serves its local residents, it also increases the utility of each and every other podcar stop in the system. Expansion to serve more of Milpitas is a LoopWorks objective.

Have you already structured projects off-balance sheet? Do you intend to for collaboration with Mark1? *

LoopWorks has not already structured projects off-balance sheet. While such creative financing efforts may be appropriate to future expansions of the proposed demonstration project, obtaining full funding of the initial system will hopefully eliminate the need for financing institutions and investors. Legal and technical guidance is expected from the design/build company contracted to build the network. Safety will be assured by the California Public Utilities Commission (CPUC) and Milpitas city engineers.

General guidance and distribution of funds will be handled by the democratically elected stakeholder representatives. The Board will consider financing options as necessary and appropriate.

Please describe the status of each certification and permits required to sell your product to your target market, if any. *

In this initial stage of project development, LoopWorks has not dealt with each specific requirement. So, the status of the following approvals and permits is “anticipated”.

Codes

The system shall be in conformance with the following codes and standards:

- American National Standards Institute (ANSI)
- Electronic Industries Association (EIA)
- Insulated Cable Engineers Association (ICEA)
- Institute of Electrical and Electronic Engineers (IEEE)
- National Electrical Code (NEC/NFPA 70)
- National Electrical Safety Code (NESC)
- National Electrical Manufacturers Association (NEMA)
- National Fire Protection Association (NFPA)
- Underwriters Laboratory (UL)

In addition to building codes adopted by the City of Milpitas, LoopWorks will follow policy guidelines in the Milpitas Metro Specific Plan such as *SD 5.2. Carbon Storage* which calls for use of building materials that store carbon (e.g. wood, calcium carbonate-based cementitious substances, synthetic limestone) in all non-residential construction.

Certification (CPUC)

Certification of a PRT system relies upon getting the permission from various government agencies that regulate the safety of things with which people interact. For example, the cabin must be designed to comply with the requirements of ISO 9000 (quality management) and NPFA 130 (guideway standards). In addition to all the applicable Codes identified above, the California Public Utilities Commission (CPUC) must certify the LoopWorks PRT system before starting public operations.

> The CPUC has safety and security regulatory authority over all rail transit and other public transit fixed guideway systems under Public Utilities Code Section 99152 and other statutes. ... The CPUC ensures that all rail transit system extensions and new construction projects undergo a safety certification review and approval.

LoopWorks will involve the CPUC early, and keep them involved throughout design, construction, and O&M (during which LoopWorks is required to report incidents that meet specific thresholds). The CPUC will focus on the project (not the technology) and the project owner (not the contractors). Thus, this CPUC-interface function is one that LoopWorks will retain as it contracts out the final design, engineering, fabrication, construction, and testing. Meetings between LoopWorks and the Milpitas Fire Department will also be held to ensure this infrastructure project supports their goals. Transit Control Solutions, Inc. (TCS), which offers a PRT control system that LoopWorks expects to employ, may also provide help working with CPUC toward certification.

The goal is attaining a CPUC General Order 164-E certification to permit LoopWorks to commence PRT operations for the public. The framework for LoopWorks' relationship with the CPUC will be *Rules and Regulations Governing State Safety Oversight of Rail Fixed Guideway Systems*. For the purpose of ensuring a high level of safety, LoopWorks has augmented these rules with its own Test Program in Task #11 of Contributions to the Development of Personal Rapid Transit by J. Edward Anderson, Volume II (pages 1495-1509).

Although General Order 164-E does not mention ASTM standards, LoopWorks will ensure that the PRT system meets the standards set by the ASTM International F-24 Committee on Amusement Rides and Devices. By doing so, the ITNS design will meet standards across the globe, thereby addressing requirements involved in deploying systems outside of California.

ASTM International is one of the largest standards-writing bodies in the world. The F-24 committee establishes standards on amusement ride design and manufacturing, testing, operation, maintenance, inspection, and quality assurances. The ASTM standards are used in 44 of 50 States and many nations. The ASTM standards:

- Are widely used and well established.
- Are tailored to pedestrians, especially children.
- Have an existing enforcement industry.
- Have an existing insurance industry.
- Have an existing common law. This is very important because privately funded transportation networks will not have the sovereign immunity that protects DOT from poor safety performance.
- Produce dramatically better injury-rates than roadways:
    - ASTM injury rates are 0.2 per million.
    - Self-regulated DOTs have a death-rate of 1.18 per 100 million VMT in the US.

Proposed Project Site: City *

Milpitas

Proposed Project Site: State *

California

Proposed Project Site: Country *

USA

What engagement, if any, have you done with the community for this project? *

LoopWorks began engaging the public in August of 2019 with the public introduction of the project. In addition to outreach efforts cited at https://milpitasprt.com/governance/documents/#presentations, a dozen media releases (https://milpitasprt.com/governance/documents/media-releases/) have been issued since 2020. Perhaps the most notable outreach effort was described in this Media Release: https://milpitasprt.com/wp-content/uploads/media-release-2022Jun-v1.pdf

Tell us about your vision for the relationship between your company and your projects. In the long term, do you intend to BDOO (build develop own & operate) projects, or do you intend to sell only a component or piece of equipment to external project operators? *

As stated in the Bylaws , the LoopWorks Mission is to "Provide climate-friendly and easy-to-use Personal Rapid Transit (PRT) for movement around Milpitas that bypasses traffic with quick, point-to-point and fare-free rides." This mission, and the unique path to success and sustainability chosen, limits growth to within Milpitas city limits - meaning that LoopWorks will initiate only one project.

While LoopWorks will own and operate the resulting podcar network, the pre-development and actual construction work will be contracted out. Loopworks hopes the Milpitas podcar system will be a see, touch, and ride inspiration to change the way transportation is viewed in cities across the world.

Our commitment to community control of commonly-used infrastructure requires:

- *Democracy and self-determination: Communities must democratically shape the transportation sector and have long-term access to and control over transportation infrastructure so that we can build wealth, health, and jobs for ourselves and future generations.*
- *Equitable Service: Our commitment to low-priced, high-quality transit service will help reduce the inequities in our community, and bolster people and families that have been disproportionately harmed by our economic system.*

The proposed dual-loop PRT system is a demonstration project that, with time and resources, could grow into a full-scale commercial (meaning profitable) facility serving 10 square miles. Because PRT is scalable, coverage could be added incrementally to the original 1.4 square-mile service area. Due to the network effect, each additional podcar stop not only serves its local users, it also increases the utility of each and every other podcar stop in the system.

Check this box if you have drafted a project proforma, and please upload.

[none]

Please upload your proforma project model.

[none]

What is the total estimated capex of the project? *

$60,000,000

What do you estimate the direct costs to be for all pre-FEED project related development costs? Please share as much detail as you can. *

Given past efforts, the ITNS design is beyond the the project pre-FEED (Front-End Engineering Design) phase. The ITNS design has been peer reviewed, and partially realized.

The prototype ITNS design that LoopWorks will employ in the Milpitas PRT project won competitions in Chicago, SeaTac, and Cincinnati. In 2003, the prototype materialized with the construction of a fully automatic vehicle for a budget of only $600,000 and 6 months from the initial order-to-proceed until operation. The vehicle operated as designed on a 60-ft section of covered-steel-truss guideway at the 2003 Minnesota State Fair 12 hours per day for 12 days with no failures. The prototype design is clear and detailed at https://milpitasprt.com/wp-content/uploads/technical-specifications.pdf

Based on that 2003 demonstration, the technology readiness level is "system prototype demonstration in an operational environment." Thus, the ITNS design awaits a specific project employing it, such as the Milpitas PRT project – for which an estimated $6M will cover all pre-construction engineering and planning. Stakeholder buy-ins plus review by a trustworthy construction company of the basic design and implementation plan will ensure both are viable.

What existing policies (including local, state and federal) are you reliant on to make your proposed project economics work? Please describe. *

As described above, PRT technology deployed at scale is expected to be profitable. Even if additional subsidies are given to Big Oil, or transit funding from the federal government disappears, the financial success of PRT technology seems likely.

Please list the risks you believe need to be resolved to execute your first commercial scale project. *

For decades, the first commercial scale project has not been impeded by engineering nor financial roadblocks. Politics, and more specifically, our weakened democracy, has been the impediment. While individuals often accept and support the technology, professional politicians do not. Although the demonstration project at Morgantown University in West Virginia has been operational for 50 years, establishment inertia has thwarted progress of the PRT industry.

Perhaps the Semmelweis Reflex best exemplifies the problem. Briefly, in the 1840's Dr. Semmelweis noticed that maternal mortality dropped by 90% when doctors washed their hands between patients. In the 1860's, Pasteur and others were investigating germ theory. By the 1880's, the practice of washing hands was being adopted, and became standard operating procedure by 1900. Aphorisms that encapsulate the problem include an Upton Sinclair quote, Overton Window, and Planck's Principle.

Overcoming establishment inertia is being assisted by 1) the urgency of our Climate Crisis, and 2) the transit-funding chaos created by the current federal regime. The combination may be sufficient to cause public agencies to embrace alternatives, and for-profit businesses to see an opportunity.

Thank you for your submission!

What are the biggest reasons you want to work with Mark1, and what are the main benefits you'd expect to draw? *

As you can see on our Trello page (https://trello.com/b/sUXK57Ix/milpitas-prt) in the column labeled "Foundations, For-Profits, and Hybrids", many organizations have been invited to join LoopWorks in this demonstration project. Very few have even replied; none have responded nor invited further input as has Mark1. That alone distinguishes Mark1 as an organization that can think beyond traditional models, and see the potential of PRT technology.

That ability to see solutions not apparent to others reminds me of Amory Lovins/RMI's concept of negawatts. RMI also pioneered the concept of "tunneling through the price barrier" of efficiency improvements by factoring in cost savings possible from smaller components. That innovative thinking seems present in Mark1.

The main benefit LoopWorks expects from our working relation is credibility. Support of the project by Mark1 will shift perception of the project from "pie in the sky" to legitimate and possible. That shift is expected to attract the attention of other power brokers and the stakeholders critical to project success.