

The HUMAN Model: Human-centric Urban Mobility through Adaptive Networks

Executive Summary

This document presents the HUMAN Model (Human-centric Urban Mobility through Adaptive Networks), a comprehensive alternative to the traditional STOMP (Walking, Cycling, Public Transport, Mobility as a Service, Private Cars) model. Rather than organizing mobility planning around transport modes, the HUMAN Model centers on human needs fulfillment through a hierarchical approach that integrates decision-making processes, recognizes diverse population groups, and leverages urban planning to minimize travel necessity.

The HUMAN Model is built on eight foundational principles and operates through a three-tier hierarchy that prioritizes needs over modes, proximity over mobility, and accessibility over speed. It explicitly integrates insights from behavioral science on travel decision-making and recognizes the diversity of emotional orientations toward mobility, ensuring that interventions resonate with different population groups.

Key Innovation: The HUMAN Model treats urban planning as the primary mobility intervention, recognizing that the best trip is the one that doesn't need to be taken. By bringing opportunities to people through 15-minute neighborhoods and complete communities, we can dramatically reduce travel necessity while improving quality of life.

Introduction: The Limitations of Mode-Centric Thinking

The STOMP model represents sophisticated thinking in mobility planning, establishing a clear hierarchy that prioritizes sustainable modes over private car use. However, as noted in recent critiques of mobility frameworks, STOMP reveals a fundamental limitation: it organizes around transport modes rather than human needs. STOMP asks "Which transport mode should people use?" but people don't wake up wondering which mode to use. They wake up asking "How do I get my children safely to school? How do I reach my aging mother who needs care? How do I access the healthcare I need? How do I maintain the social connections that give my life meaning?"

The mode is merely instrumental. The need is fundamental. This distinction is not semantic, it has profound implications for how we design, evaluate, and implement mobility systems. A mode centric approach can lead to celebrating bike sharing systems without asking whether they serve care trips for parents juggling multiple children, or building mobility hubs without considering whether they support the complex journey chains of caregivers.

The HUMAN Model (Human-centric Urban Mobility through Adaptive Networks) presented here addresses these limitations by centering human needs and recognizing the full complexity of travel decision-making. The name itself embodies the paradigm shift: from mode centric to human-centric planning, from static hierarchies to adaptive networks that respond to diverse needs and contexts.

Part I: Foundational Principles of the HUMAN Model

The HUMAN Model rests on eight interconnected principles that guide all mobility planning and policy decisions. These principles operationalize the model's core commitment to human centric planning and adaptive networks.

1. Needs-Centered Design

Principle: Mobility systems exist to enable human flourishing, not to move vehicles efficiently.

Traditional STOMP asks "Which transport mode should people use?" The HUMAN Model asks "How can people access what they need for a fulfilling life?" This fundamental shift recognizes that travel is derived demand, people travel to pursue activities, opportunities, and connections, not for travel's sake. The framework organizes around the nine essential human needs detailed in the table below, drawing on Max-Neef's taxonomy of fundamental human needs.

Need Category	Description	Mobility Implication
Subsistence	Access to employment, food, shelter, and essential services	Enables economic participation and meeting basic material needs
Protection	Physical safety, reliable access to healthcare, and security in traveling	Provides safe infrastructure and dependable services
Affection	Maintaining relationships with friends and family, and community participation	Enables social connection and strengthens social bonds
Understanding	Access to education, cultural venues, libraries, and learning opportunities	Supports intellectual growth and curiosity
Participation	Engagement in civic life, community meetings, voting, and volunteering	A prerequisite for democratic participation
Leisure	Access to parks, recreation, nature, and entertainment	Serves joy, play, and restoration
Creation	Access to maker spaces, workshops, artistic venues, and places to innovate	Supports human creativity and productive activity
Identity	Allowing expression of personal values and cultural identity	Enables choices that reflect environmental or cultural values
Freedom	Autonomy, flexibility, and the ability to choose	Provides a range of choices to suit individual circumstances

Every mobility intervention must be evaluated against its contribution to these nine needs across all population groups. This represents a shift from measuring success by mode share or vehicle kilometers traveled to measuring success by the ability of diverse populations to access the opportunities that enable human flourishing.

2. Proximity Before Mobility

Principle: The best trip is the one that doesn't need to be taken.

Before considering how people should travel, the framework asks whether travel is necessary at all. Urban planning becomes the primary mobility intervention by bringing opportunities to

people rather than requiring people to travel to opportunities. This principle operates through the creation of 15-minute neighborhoods, where daily needs are accessible within a short walk or cycle, and complete neighborhoods, where all nine human needs can be satisfied locally.

This is achieved through mixed use development that integrates residential, commercial, and civic functions; distributed services rather than centralized mega facilities; human scale urban design with short blocks and permeable networks; and support for local employment and remote work infrastructure. The proximity principle directly addresses the trip/no-trip decision, the first and most fundamental choice in the travel decision process. By enabling virtual substitution (telecommuting, online services), spatial substitution (local alternatives), and temporal substitution (flexible scheduling), urban planning reduces the necessity for physical travel.

Research demonstrates that central neighborhoods often have faster average commutes than suburban ones despite slower modes, because proximity matters more than speed. Residents accessing more opportunities without driving report better health, stronger social connections, and lower transportation costs. The evidence is clear: when we center human needs and minimize travel necessity through thoughtful urban design, everyone benefits.

3. Accessibility Over Speed

Principle: Success is measured by opportunities reached, not by vehicle velocity.

Traditional mobility planning prioritizes speed and throughput, measuring success by average travel speeds or level of service for vehicles. The HUMAN Model prioritizes accessibility, the ease with which people of diverse abilities can reach the activities and opportunities that matter to them. An elderly person reaching a doctor's office via a 10-minute walk represents superior accessibility compared to a 30-minute drive, even though the car travels faster.

Accessibility accounts for multiple dimensions: door-to-door time (total journey time including access, waiting, and egress, not just in-vehicle time), reliability (consistency and predictability of travel times), universal design (usability for people of all ages and abilities), cognitive load (mental effort required for navigation and coordination), and opportunity density (number and quality of destinations reachable within given time thresholds).

This principle aligns with the multi criteria evaluation that people naturally perform when making travel decisions. Research on travel behavior shows that people consider time, cost, comfort, effort and stress, safety and security, and values and identity, not just speed. By measuring accessibility rather than speed, we create systems that serve the full range of human needs and circumstances.

4. Context-Sensitive Differentiation

Principle: One size never fits all, mobility systems must serve diverse circumstances and identities.

The framework recognizes that people differ not only demographically but also in their emotional orientations toward mobility. Drawing on Michel Maffesoli's concept of neo-tribes, fluid communities united by shared moods and values rather than fixed demographics, the

framework identifies distinct emotional tribes with different needs and motivations, as summarized in the table below. Note: Other definitions are possible.

Emotional Tribe	Core Value	Mobility Preference	Effective Interventions
Freedom-Seekers	Autonomy, adventure, self-expression	Flexible, spontaneous, on-demand options	Frame initiatives as liberation; emphasize choice and flexibility
Safety-Driven Families	Protection, trust, security	Safe infrastructure, predictable services	Co-create with communities; visible safety measures; "Love 30" campaigns
Eco-Activists	Sustainability, environmental stewardship	Visible impact, collective action	Gamified challenges; real-time impact displays; community competitions
Tech-Experimenters	Innovation, optimization, novelty	Cutting-edge technology, real-time feedback	Hackathons; pilot programs; gamified safety apps

These emotional tribes illustrate how varied the emotional landscape of urban mobility is. The key is not to coerce people into "good" behavior but to align mobility initiatives with the narratives and aspirations that already resonate within these communities. Effective mobility systems speak to the heart as much as to the brain, feeling personal, meaningful, and inclusive.

Beyond emotional tribes, the framework recognizes life context diversity. Parents with children manage complex care trip chains involving multiple destinations, time constraints, and cargo (strollers, groceries, sports equipment). The elderly require accessible, reliable, low-stress options with frequent seating, weather protection, and intuitive wayfinding. People with disabilities need universal design that assumes diverse abilities from the outset. Shift workers require 24/7 service availability. Low income households face transport poverty, spending disproportionate shares of income on mobility. Rural residents contend with different density and distance realities. Each of these contexts requires tailored approaches, not one-size-fits-all solutions.

5. Habit-Aware Implementation

Principle: Most travel is habitual, not consciously chosen, work with habits, not against them.

Research on travel behavior demonstrates that the majority of trips follow established routines with minimal conscious deliberation. Habits form through repetition in stable contexts and become automatic responses to contextual cues, the automatic reach for car keys, the mental maps of roads and parking, the embodied knowledge of driving. The framework acknowledges this reality and designs interventions accordingly.

Working with habits means targeting life transitions, moving house, changing jobs, becoming a parent, retiring, moments when habits are disrupted and people are open to new patterns. It means creating positive first experiences with new mobility options, ensuring that initial encounters are comfortable, successful, and memorable, as these experiences shape whether new habits will form. It means establishing stable contexts where new habits can take root, providing consistent, reliable services rather than constantly changing offerings. And it means accepting gradual behavior change, recognizing that transformation happens incrementally through thousands of small decisions, not overnight through dramatic shifts.

The framework recognizes that decisions operate at three temporal scales. **Operational decisions** (daily mode and route choices) are largely habitual and automatic. **Tactical decisions** (activity scheduling, trip chaining, periodic evaluation of patterns) involve more conscious thought and offer opportunities for intervention through personalized journey planning and feedback. **Strategic decisions** (residential location, vehicle ownership, long term commitments) are infrequent but high stakes choices that constrain all subsequent decisions, these are the leverage points for transformative change.

Habit disruption factors to leverage include life transitions and critical incidents (accidents, delays, safety concerns), contextual changes (new infrastructure, service improvements), accumulated dissatisfaction (reaching a threshold where the old pattern no longer works), and social influence (peer modeling and community norms). By understanding and working with these factors, interventions become more effective and less coercive.

6. Multi-Temporal Integration

Principle: Mobility decisions operate across three time scales that must be addressed coherently.

The framework integrates interventions across strategic, tactical, and operational time horizons, ensuring that actions at each level are mutually reinforcing rather than contradictory.

Strategic Level (Months to Years) encompasses residential and workplace location decisions, vehicle ownership and access arrangements, long-term mobility subscriptions and commitments, and infrastructure investments that shape urban form. These high-stakes, infrequent decisions create strong constraints on shorter-term choices. Urban planning interventions operate primarily at this level, shaping the spatial structure that determines whether proximity-based access is possible. A decision to live in a car-dependent suburb constrains daily mobility choices for years; conversely, choosing a complete neighborhood enables car-free living.

Tactical Level (Days to Weeks) involves activity scheduling and trip chaining, mode and route exploration and learning, periodic evaluation of mobility patterns, and seasonal adaptations. This intermediate level involves moderate-stakes decisions with some flexibility. Interventions include mobility counseling, personalized journey planning, feedback on travel patterns, and support for optimizing trip chains to reduce total travel burden.

Operational Level (Minutes to Hours) encompasses daily mode and route choices, departure timing and real-time adaptations, immediate responses to conditions, and habitual execution. This level involves frequent, often automatic decisions. Interventions include real time information systems, seamless payment mechanisms, and frictionless mode integration that make sustainable choices the easiest choices.

The framework ensures coherence across these levels. For example, investing in 15-minute neighborhoods (strategic) enables people to schedule activities locally (tactical), which in turn makes walking and cycling the habitual choice for daily trips (operational). Without this coherence, interventions can work at cross-purposes, promoting cycling while continuing to approve car dependent suburban development, or encouraging public transit use while failing to provide the reliable service that would allow new habits to form.

7. Seamless Integration

Principle: Multimodal journeys must be effortless, not burdensome.

While traditional STOMP establishes a mode hierarchy, the HUMAN Model recognizes that real journeys often combine multiple modes. A trip might involve walking to a bike-share station, cycling to a transit hub, taking a train, and walking to the final destination. Each transition point introduces potential friction, physical barriers, information gaps, payment hassles, temporal mismatches, cognitive complexity.

Seamless integration requires physical connectivity through co-located stops, protected transfer paths, and mobility hubs that bring multiple modes together in well designed spaces. It requires information integration through unified journey planning apps that cover all modes, real-time updates on availability and conditions, and personalized recommendations based on trip purpose and user context. It requires payment integration through single accounts or payment methods that work across all modes, transparent pricing, and mobility budgets or subscriptions that enable flexible use. It requires temporal coordination through synchronized schedules, minimized transfer times, and guaranteed connections. And it requires cognitive simplicity through intuitive wayfinding, clear communication, and reduced mental burden.

The framework treats mobility hubs not merely as transfer points but as community anchors, places that integrate mobility services with childcare, healthcare, co-working, and social spaces. This transforms the friction of mode transfers into opportunities for community connection. A mobility hub, or better referred to as community hub, becomes a place where neighbors encounter each other, where teenagers gather, where information gets exchanged. Mobility is integrated with life, not separated from it.

8. Continuous Learning and Adaptation

Principle: Systems must learn from lived experiences and evolve accordingly.

The travel decision process includes a critical learning and feedback phase. After each journey, people evaluate their experience against expectations, form satisfaction judgments, attribute causes to outcomes, and store memories that shape future choices. This learning operates at three levels: operational feedback (immediate adjustments to the next trip, such as route changes or mode shifts), tactical feedback (modifications to behavior patterns, such as trip frequency or destination habits), and strategic feedback (impacts on major life choices, such as residential location or vehicle ownership).

The framework institutionalizes learning through participatory monitoring that engages diverse communities in ongoing evaluation, real time feedback systems that collect experience data through apps and sensors, rapid iteration of pilot projects with built-in evaluation and adaptation, co-creation processes that involve residents in designing and refining interventions, and transparent metrics that publicly share accessibility and needs fulfillment data.

This principle recognizes that no framework can be perfect from inception, it must evolve through continuous dialogue between system designers and system users. Those closest to mobility challenges often hold the most innovative solutions. Parents must design systems serving complex care trips. People with disabilities must lead accessibility planning. Those

experiencing transport poverty must shape solutions to transport poverty. This isn't just ethical, it's practical, ensuring that interventions address real needs rather than assumed needs.

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Part II: The Three-Tier Hierarchy of the HUMAN Model

The HUMAN Model replaces STOMP's mode hierarchy with a **three-tier needs-based hierarchy**. Each tier builds on the previous one, creating a coherent system for mobility planning and policy. This hierarchical structure embodies the model's adaptive network approach, where interventions at each level respond to and reinforce the others. The diagram below illustrates the structure and relationships among the three tiers.

TIER 1: NEEDS FULFILLMENT

Ensure access to nine essential human needs

- Subsistence
- Protection
- Affection
- Understanding
- Participation
- Leisure
- Creation
- Identity
- Freedom

TIER 2: PROXIMITY & SPATIAL ORGANIZATION

Minimize travel necessity through urban planning

- 15-Minute Neighborhoods
- Complete Neighborhoods
- Polycentric Structure
- Virtual/Temporal Substitution

TIER 3: MODAL FLEXIBILITY & INTEGRATION

Provide abundant, integrated options

- Active Modes
- Personalized and flexible
- Collective transport
- Target groups solutions (elderly, disabled)
- Private Vehicles

Tier 1: Needs Fulfillment and Opportunity Access

Priority: Ensure all residents can access the nine essential human needs.

This foundational tier asks "What opportunities must people be able to reach for a fulfilling life?" Before considering any transport modes, planners must map the spatial distribution of opportunities across the nine need categories: essential services (healthcare facilities, emergency services, government offices), economic opportunities (employment centers, job training, entrepreneurship support), education and learning (schools, universities, libraries, cultural venues), social infrastructure (community centers, places of worship, gathering

spaces), care facilities (childcare, eldercare, disability services), recreation and nature (parks, sports facilities, natural areas), food and retail (grocery stores, markets, essential shopping), and creative spaces (maker spaces, studios, performance venues).

Evaluation at this tier focuses on critical questions: What percentage of residents can access each need category within 15 minutes by walking or cycling? What percentage can access each need category within 30 minutes by any available mode? Are there systematic gaps by neighborhood, income level, age, or ability? Which needs are most difficult to access, and for whom? These questions reveal the baseline accessibility landscape and identify priorities for intervention.

Interventions at Tier 1 include mapping accessibility gaps using GIS tools combined with participatory methods that capture local knowledge, engaging communities to identify priority needs and barriers through workshops and surveys, setting accessibility targets for each need category with specific, measurable goals, and establishing baseline metrics for continuous monitoring. This tier operationalizes the needs-centered design principle and provides the foundation for all subsequent planning. Without understanding what people need to access, we cannot design effective mobility systems.

Tier 2: Proximity and Spatial Organization

Priority: Minimize travel necessity through urban planning and land use.

Once needs and opportunities are mapped, Tier 2 asks "How can we bring opportunities closer to people?" This tier recognizes that urban planning is the most powerful mobility intervention. Spatial strategies operate at multiple scales to reduce travel necessity.

15-Minute Neighborhoods organize urban space so that daily needs—work, education, healthcare, shopping, recreation—are accessible within 10-15 minutes by active modes (walking, cycling). This requires mixed-use zoning that integrates residential, commercial, and civic functions rather than separating them into single-use districts; distributed services rather than centralized mega-facilities that require long-distance travel; human-scale urban design with short blocks and permeable networks that make walking and cycling pleasant and efficient; and local employment opportunities combined with remote work infrastructure that reduces commuting necessity.

Complete Neighborhoods go beyond 15-minute access to daily necessities, ensuring that all nine human needs can be substantially satisfied within local areas. This encompasses social infrastructure for affection and participation needs (community centers, gathering spaces), cultural venues for understanding and identity needs (libraries, cultural centers, places of worship), creative spaces for creation and leisure needs (maker spaces, parks, sports facilities), and healthcare and safety infrastructure for protection needs (clinics, police, fire services). Complete neighborhoods enable people to build full, rich lives without constant long-distance travel.

Polycentric Regional Structure develops regions with multiple centers of activity rather than monocentric cities with single employment cores. This reduces average travel distances and enables more trips to be satisfied locally or through shorter connections between nearby centers. It also provides resilience, as people have multiple options for accessing opportunities rather than depending on a single distant center.

Virtual and Temporal Substitution enables the trip/no-trip decision to favor no-trip alternatives. This includes telecommuting infrastructure and policies that allow people to work from home or neighborhood co-working spaces, online service delivery for appropriate functions (shopping, healthcare consultations, government services), flexible scheduling that allows temporal shifting of activities to off-peak times or consolidation of multiple errands into single trips, and home-based and neighborhood-based alternatives to distant services.

Evaluation at this tier focuses on outcomes: What percentage of trips can be eliminated through proximity and substitution? How many jobs are accessible within 15 minutes? Within 30 minutes? What is the average distance to each need category? How equitably is proximity distributed across neighborhoods and populations? These metrics reveal whether spatial organization is effectively reducing travel necessity.

Interventions at Tier 2 include zoning reforms to enable mixed-use development, strategic location of public services and facilities to maximize accessibility, investment in distributed infrastructure rather than centralized mega-projects, incentives for local employment and remote work, and neighborhood-scale planning with community participation. This tier operationalizes the proximity before mobility principle and directly addresses the strategic level of decision-making by shaping residential location choices and long-term spatial patterns.

Tier 3: Modal Flexibility and Seamless Integration

Priority: For trips that remain necessary, provide abundant, integrated, accessible options.

After maximizing proximity and minimizing travel necessity, Tier 3 addresses the trips that still need to occur. Rather than prescribing a universal mode hierarchy (always prefer walking over cycling over transit over cars), this tier provides modal flexibility matched to diverse trip purposes and individual circumstances. The table below outlines the appropriate use cases and design requirements for different modal categories.

Modal Category	Appropriate Use Cases	Design Requirements
Active Modes (Walking, Cycling)	Short distances, healthy individuals, good weather, flat terrain, light cargo	Safe, separated infrastructure (sidewalks, protected bike lanes); weather protection where feasible; secure bike parking; cargo bike infrastructure; universal design for mobility aids; pleasant, attractive environments
Personalized and flexible	Medium distances, first/last mile connections, spontaneous trips, visitors	Abundant, well-distributed stations or service areas; reliable maintenance and availability; integration with other modes at mobility hubs; pricing that enables frequent use; safety equipment and user education
Collective	Medium to long distances, high-capacity corridors, regular commutes, mobility-limited individuals	Frequent, reliable service minimizing waiting times; comfortable vehicles and stations; universal accessibility (level boarding, audio/visual information); direct routes and convenient connections; affordable pricing with social tariffs
Target group solutions	Complex trip requirements (e.g. mobility limited individuals)	Availability across neighborhoods; range of vehicle types (standard, accessible, cargo); transparent, fair pricing

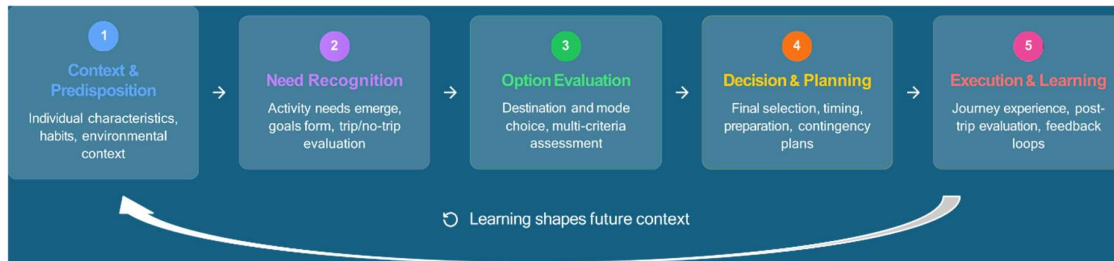
Private Vehicles (Personal Cars, Motorcycles)	Specific circumstances where other modes cannot meet needs (rural areas, complex care trips, certain disabilities, specialized cargo)	Transition to zero-emission vehicles; efficient use through car-sharing within households or communities; appropriate infrastructure without dominating urban space; pricing that reflects full social and environmental costs
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This tier operationalizes the modal flexibility, seamless integration, and context-sensitive differentiation principles. The emphasis is on creating a cohesive, user-friendly multimodal system where the right mode for each trip is readily available and easy to use. Integration requirements, physical connectivity, information integration, payment integration, temporal coordination, and cognitive simplicity, are as important as modal provision itself.

Evaluation at this tier focuses on system performance: What percentage of residents have access to at least three different mode options? How long does it take to complete multimodal journeys compared to single-mode alternatives? What is user satisfaction across different modes and population groups? Are there systematic gaps in modal access by neighborhood, income, age, or ability? How well do available modes serve different trip purposes (commute, care, shopping, leisure)? These metrics reveal whether the modal system is truly serving diverse needs.

Part III: Decision Process Integration in the HUMAN Model

The HUMAN Model explicitly integrates the five-phase travel decision process, recognizing that effective mobility systems must support people through each phase. This integration reflects the model's adaptive nature, understanding how people actually make travel decisions allows the system to respond intelligently to real behavior rather than idealized assumptions. The diagram below illustrates the decision process and the cyclical nature of learning.



Phase 1: Context and Predisposition

Framework Response: Shape the context to make sustainable, accessible choices the default.

The framework recognizes that individual characteristics (demographics, psychographics, mobility competence) and environmental context (infrastructure, built environment, socio-cultural norms) create the foundation for all travel decisions. Interventions at this phase include infrastructure investment that makes sustainable modes safe, convenient, and attractive; built environment design that supports proximity and active modes; cultural change through storytelling, role modeling, and community engagement; multimodal competence building through education and experiential programs; and tailored approaches for different emotional tribes with messaging and services that resonate with their values.

Phase 2: Need Recognition and Goal Formation

Framework Response: Reduce mandatory travel through proximity; support flexible scheduling for maintenance and discretionary activities.

The framework distinguishes between mandatory activities (work, school, medical appointments) with fixed schedules and high importance, maintenance activities (shopping, errands) with flexible timing and moderate importance, and discretionary activities (social, recreation) with high flexibility. Interventions include proximity planning (Tier 2) that reduces travel necessity for all activity types, virtual substitution enabling remote work and online services, spatial substitution providing local alternatives to distant destinations, temporal substitution allowing flexible scheduling and trip consolidation, and activity scheduling support helping people optimize trip chains.

Phase 3: Option Evaluation (Destination and Mode Choice)

Framework Response: Provide abundant, well-integrated options that satisfy multi-criteria evaluation.

People evaluate destinations and modes across multiple dimensions: time, cost, comfort, effort and stress, safety and security, and values and identity. The framework ensures that sustainable, accessible options perform well across ALL criteria, not just environmental impact. Interventions include destination choice support with information on accessibility, quality, and experience; ensuring mode feasibility across physical, legal, personal, and resource dimensions; multi-criteria optimization designing modes that satisfy time, cost, comfort, effort, safety, AND values; personalized recommendations tailored to trip purpose, user context, and emotional tribe; and transparent comparison with clear information enabling informed choices.

Phase 4: Decision and Planning

Framework Response: Make sustainable choices the easiest to plan and execute.

Once evaluation is complete, people must commit to a specific mode, route, and timing, then prepare for the journey. Interventions include simplified planning through unified apps and information systems, reduced preparation burden through pre-registered accounts and stored payment methods, contingency support with real time information and backup options, cognitive load reduction through intuitive wayfinding and clear communication, and confidence building through reliable services that people can trust.

Phase 5: Execution and Learning

Framework Response: Deliver excellent experiences that create positive feedback loops.

The journey itself is a lived experience with emotional, physical, and cognitive dimensions. Post trip evaluation shapes future choices through operational, tactical, and strategic feedback. Interventions include experience quality ensuring comfortable, safe, pleasant journeys; real-time adaptation support with information and options for managing disruptions; positive reinforcement through gamification, social recognition, and visible impact displays; feedback collection systematically gathering user experiences; rapid response with quick fixes to identified problems; and continuous improvement through iterative refinement based on learning.

Part IV: Implementation Framework for the HUMAN Model

The implementation of the HUMAN Model follows a structured twelve-step process organized into four phases. This implementation framework embodies the model's commitment to adaptive networks through iterative, participatory processes that learn and evolve.

Assessment and Baseline (Steps 1-3)

Step 1: Needs and Accessibility Mapping involves mapping the nine human needs across the region, assessing current accessibility for different population groups, identifying systematic gaps and inequities, and engaging communities in participatory mapping that captures local knowledge and priorities.

Step 2: Emotional Tribes and Context Analysis includes identifying the distribution of emotional tribes in the population, understanding life context diversity (families, elderly, people with disabilities, etc.), assessing current mobility patterns and satisfaction levels, and identifying barriers and pain points for different groups.

Step 3: Decision Process Analysis encompasses understanding habitual patterns and their stability, identifying life transitions and moments of openness to change, assessing multi-criteria evaluation priorities for different trip types, and mapping feedback loops and learning mechanisms.

Strategic Planning (Steps 4-6)

Step 4: Set Accessibility Targets involves defining targets for each need category (e.g., "90% of residents can access healthcare within 20 minutes"), establishing equity criteria ensuring no group is systematically excluded, setting intermediate milestones and long term goals, and committing to transparent, public monitoring.

Step 5: Develop Proximity Strategy includes identifying opportunities for mixed use development and service distribution, reforming zoning and land-use regulations, planning strategic location of public facilities, and investing in neighborhood scale infrastructure.

Step 6: Design Modal System encompasses assessing current modal provision and gaps, planning infrastructure investments prioritized by accessibility gaps, designing services tailored to emotional tribes and life contexts, and developing integration platforms and technologies.

Tactical Implementation (Steps 7-9)

Step 7: Pilot and Iterate involves implementing pilot projects in diverse neighborhoods, engaging communities in co-creation and evaluation, collecting real-time feedback and experience data, and rapidly iterating based on learning.

Step 8: Scale and Mainstream includes expanding successful interventions to broader areas, institutionalizing continuous learning processes, building political and public support through

visible successes, and addressing resistance through compassionate acknowledgment of what is ending (hospice work) and bridge building between old and new systems.

Step 9: Monitor and Adapt encompasses tracking accessibility metrics for all nine needs, monitoring satisfaction and experience quality across population groups, assessing equity and identifying emerging gaps, and adapting strategies based on changing contexts and needs.

Governance and Participation (Steps 10-12)

Step 10: Establish Participatory Structures involves creating "Mobility Tribes Councils" with representatives from diverse groups, institutionalizing community co-creation in planning processes, ensuring meaningful participation rather than token consultation, and building capacity for ongoing civic engagement.

Step 11: Foster Multi-Stakeholder Collaboration includes coordinating across planning, transport, health, education, and social services; engaging the private sector in service provision and innovation; building partnerships with community organizations; and creating bridge-building roles connecting different sectors and perspectives.

Step 12: Communicate and Celebrate encompasses telling compelling stories of transformation, celebrating successes and visible improvements, providing transparent data on progress toward goals, and building shared identity around accessibility and needs fulfillment.

Part V: Measuring Success in the HUMAN Model

The HUMAN Model requires fundamentally different metrics than traditional mobility planning, shifting from measuring vehicle movement to measuring human flourishing. These metrics operationalize the model's human-centric focus and enable the adaptive networks to learn and improve continuously.

Primary Metrics: Needs Fulfillment

For each of the nine human needs, the framework tracks the percentage of population able to access the need within 15 minutes by active modes, the percentage able to access the need within 30 minutes by any mode, the average time required to access the need across the population, and equity measures revealing gaps by neighborhood, income, age, and ability.

Example metrics:

- Subsistence (employment): "75% of residents can access at least 50,000 jobs within 30 minutes"
- Protection (healthcare): "95% of residents can access primary care within 15 minutes"
- Affection (social): "80% of residents can reach friends/family within 30 minutes"

Secondary Metrics: Proximity and Substitution

These metrics evaluate the effectiveness of Tier 2 interventions: percentage of trips eliminated through virtual, spatial, or temporal substitution; average distance to each need category; percentage of neighborhoods qualifying as "15-minute neighborhoods"; and percentage of neighborhoods qualifying as "complete neighborhoods" where all nine needs are substantially satisfiable locally.

Tertiary Metrics: Modal Performance

Accessibility metrics measure opportunities reachable within time thresholds by different modes, door-to-door journey times including access, waiting, and egress, and reliability and consistency of travel times.

Experience quality metrics assess user satisfaction across modes and population groups, comfort, safety, and stress levels, and ease of planning and execution.

Integration metrics evaluate the percentage of population with access to three or more mode options, multimodal journey times compared to single-mode alternatives, and friction at transfer points (waiting times, physical distance, cognitive load).

Equity metrics reveal accessibility gaps by neighborhood, income, age, and ability; transport poverty indicators; and systematic exclusion of any groups.

Outcome Metrics: Human Flourishing

Ultimately, the framework's success is judged by its impact on human wellbeing across multiple dimensions.

Health outcomes include physical activity levels, air quality and respiratory health, traffic injury and fatality rates, and mental health and stress indicators.

Social outcomes encompass social connection and community cohesion, civic participation rates, and reductions in loneliness and isolation.

Economic outcomes measure employment accessibility and participation, transport cost burden on households, and economic productivity and opportunity.

Environmental outcomes track greenhouse gas emissions, air and noise pollution levels, and urban green space and biodiversity.

Conclusion: From STOMP to HUMAN—From Modes to Needs

The traditional STOMP model served an important purpose in prioritizing sustainable modes over private car use. However, its mode-centric logic limits its ability to serve the diverse, complex realities of human life. The HUMAN Model (Human-centric Urban Mobility through Adaptive Networks) represents a fundamental paradigm shift: from asking "which mode should people use?" to asking "how can people flourish?"

By organizing around nine essential human needs, establishing a three-tier hierarchy that prioritizes needs over modes and proximity over mobility, integrating the five-phase decision process, and recognizing diverse emotional tribes and life contexts, this framework offers a more comprehensive, humane, and effective approach to mobility planning.

The framework acknowledges that transformation is uncomfortable and requires multiple roles: pioneers experimenting with alternatives, connectors building networks, illuminators sharing stories, bridge builders facilitating transition, and hospice workers honoring what is ending. It works with human nature, habits, emotions, values, rather than against it.

Most importantly, the HUMAN Model recognizes that urban planning is the most powerful mobility intervention. By bringing opportunities to people through 15-minute neighborhoods, mixed-use development, and complete communities, we can dramatically reduce travel necessity while improving quality of life. The best trip is the one that doesn't need to be taken.

For the trips that remain necessary, the HUMAN Model provides abundant, integrated, accessible options tailored to diverse circumstances. It measures success not by vehicle speed but by opportunities reached, not by mode share but by needs fulfilled, not by engineering efficiency but by human flourishing.

The HUMAN Model is the future of mobility planning: Human-centric in its focus on needs fulfillment, Urban in its recognition that planning is the primary intervention, Multimodal in its embrace of flexibility over hierarchy, Adaptive in its responsiveness to diverse contexts and continuous learning, and Network-oriented in its emphasis on seamless integration and community connection. It is a framework worthy of the transformation we seek, from car-centric decline to people-centered emergence, from mobility as individual consumption to access as shared infrastructure supporting collective wellbeing.

References and Further Reading

The HUMAN Model synthesizes insights from multiple sources:

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