

Accessibility and Transport Appraisal

ITF roundtable

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Accessibility: A universal tool?

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The point of view

- A practitioner's point of view
 - No brand new research result ...
 - ... But taking stock of the state of scientific approaches and results in several fields where accessibility-like formulations are used,
 - Comparing them, discussing their accuracy for public policy decision issues and more generally the use of accessibility for providing a broader view for policy making
 - Based on two working papers for the world Bank:
 - “Welfare and growth effects in transport and trade” E Quinet and A Raj, 2015
 - “Accessibility in practice” D Meunier and E Quinet, in progress

FOCUS: THE CENTRAL? ROLE OF ACCESSIBILITY

Accessibility in general

- An appealing concept, widely used in transportation, trade and spatial economics, as well as in other disciplines (geography, sociology, ...)
- A variety of definitions, meanings and measurements

Accessibility in general

- Various types of indicators embedding with various degrees:
 - Emission factors (exports, GDP, homes of workers) at origins
 - Reception factors (imports, Domestic Consumption, employments) at destinations
 - Impedance: distance, time, money cost, generalized cost (time+money), embedded in a decay function
 - Basic classifications:
 - International / interregional / local accessibility
 - Passengers / freight
 - Access to various amenities (jobs / services) or to a (rapid) network

Indicators

- The diversity of practices
 - Regularly updated indicators published as open statistics
 - UK, USA, France
 - Criteria for designing indicators:
 - Availability of data
 - Communicability
 - Sensitivity of the results
 - Policy concerns

European Union: integration and development

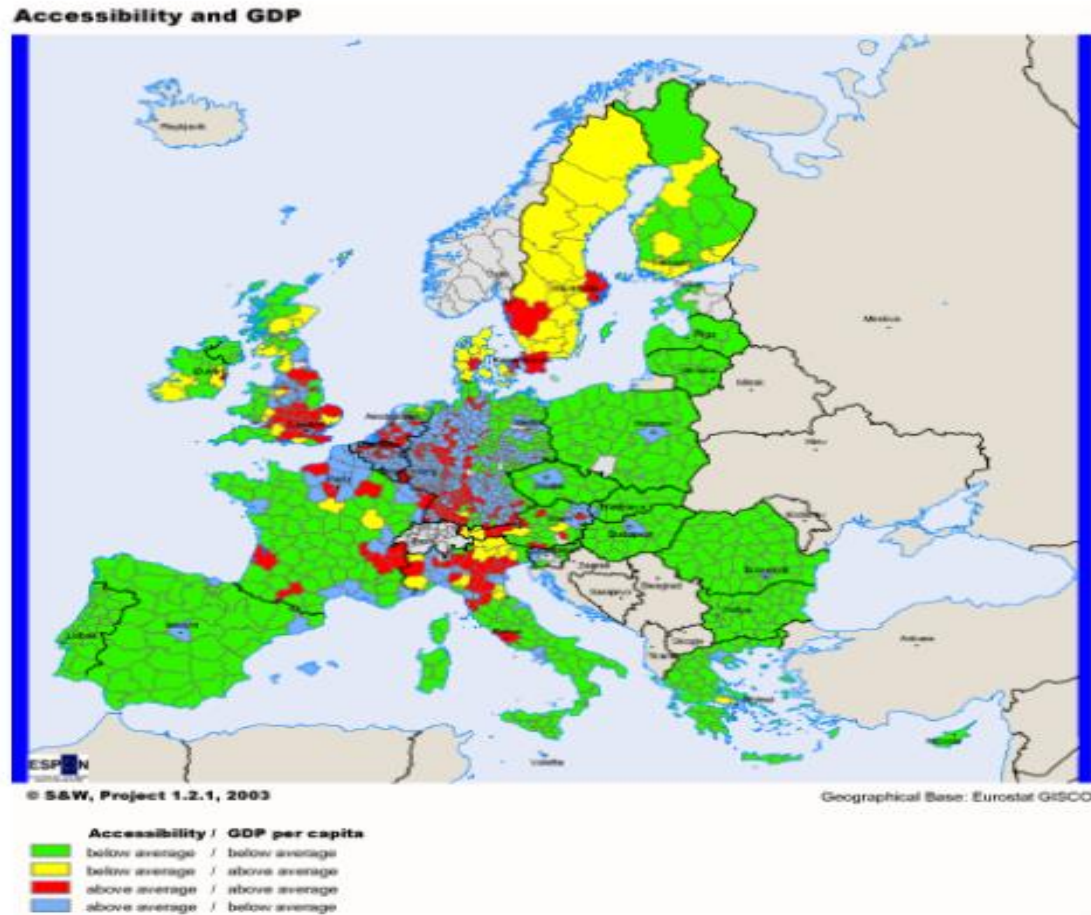


Figure .7.2.2. Accessibility and GDP per capita in NUTS-3 regions

European Union: integration and development

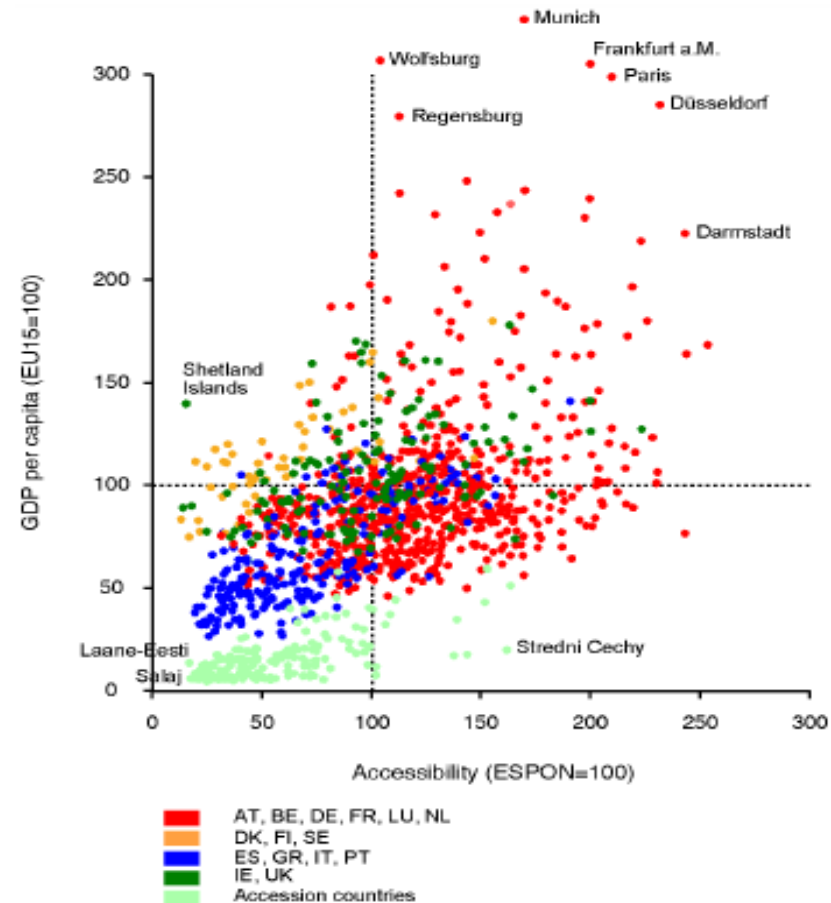
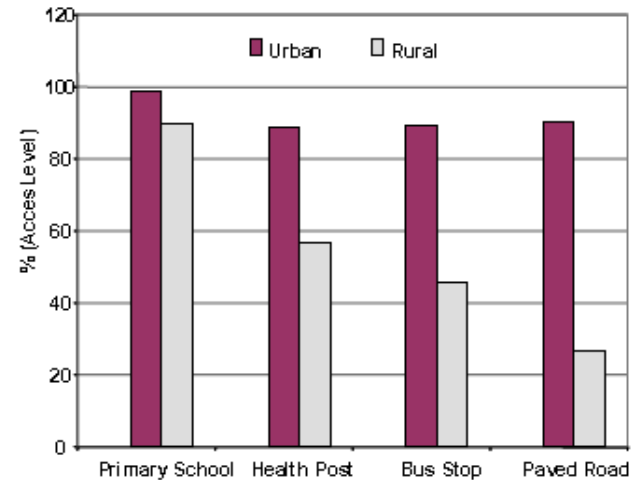


Figure 7.2.1. Accessibility and GDP per capita in NUTS-3 regions

The World Bank

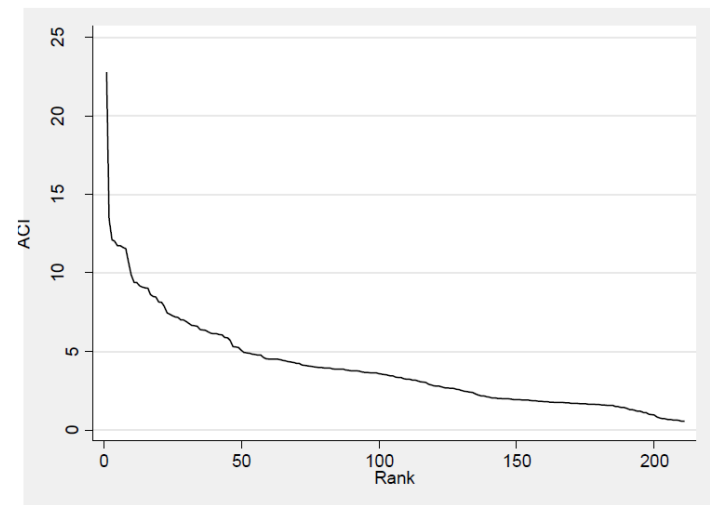
- Rural accessibility index



Source, Nepal Census Bureau.

Figure 8: ACI score vs. rank.

- Air connectivity index



In both trade and transport the modeling of flows between nodes implies gravity models, and the aggregation of flows to or from each node leads to accessibility indicators, whose precise formula depends on whether the flows arriving at or starting from each node are constrained or not

THE THEORETICAL BASES OF ACCESSIBILITY

The transport tradition

- Discrete choices models (Mc Fadden, Ben Akiva, Cochrane),
 - RUM: indirect utility of i for good j is: $V_{ij} = \bar{V}_i + U_{ij} + \varepsilon_{ij}$
 - Implies additive utility (constant marginal utility of income)
 - If ε_{ij} follows Gumbel pdf, the proportion of j choice is:

$$p_{ij} = \frac{e^{\lambda_i * U_{ij}}}{\sum_j e^{\lambda_i * U_{ij}}} \quad (1)$$

- And the consumer's surplus is the logsum:

$$CS = \frac{1}{\lambda_i} \text{Log} \left[\sum_j \exp(U_{ij}) \right]$$

The transport tradition

- The single constrained model:
 - Introducing the number of people O_i at origin i and the number of opportunities at destination D_j , if all destinations have same utility u_i and transport cost is c_{ij} , then:

$$U_{ij} = u_i - c_{ij}$$

- We get an avatar of the gravity formula, the single constrained model:

$$T_{ij} = O_i * \frac{D_j * e^{-\lambda * c_{ij}}}{\sum_j D_j * e^{-\lambda * c_{ij}}}$$

- Extended to the case where utilities D_j are drawn from a pdf, and i maximizes its utility (Cochrane).
- Assuming these agents have the same utility function, their surplus is:

$$S = \sum_i S_i = O_i * \log \left[\sum_j D_j * e^{-\lambda * c_{ij}} \right]$$

The transport tradition

- The double constrained model:
 - In the case the number of arrivals in a given destination is constrained, the traffics can be expressed as:

$$T_{ij} = O_i * D_j * A_i * B_j * e^{-\lambda * c_{ij}}$$

- Where O_i is the total emission of zone i and D_j the total attraction (capacity) of zone j , and:

$$A_i = \left(\sum_k B_k * D_k * e^{-\lambda * c_{ik}} \right)^{-1}$$

$$B_j = \left(\sum_r A_r * O_r * e^{-\lambda * c_{rj}} \right)^{-1}$$

The trade tradition

- The CES function (Armington): iceberg cost, full employment and,

$$U_j = \left(\sum_i \beta_i^{(1-\sigma)/\sigma} * c_{ij}^{(1-\sigma)/\sigma} \right)^{\sigma/(1-\sigma)}$$

With the budget constraint for consumers in j: $\sum_i p_{ij} * c_{ij} = y_j$

- Flows are: $p_{ij} * c_{ij} = x_{ij} = \left[\frac{\beta_i * p_i * t_{ij}}{P_j} \right]^{(1-\sigma)} * y_j$
- Where P_j is the price index in j: $P_j = \left[\sum_i (\beta_i * p_i * t_{ij})^{1-\sigma} \right]^{1/(1-\sigma)}$
- Taking into account the constraint of exporters

income yields:

$$\Pi_i = \left(\sum_j \left(\frac{p_i * t_{ij}}{P_j} \right)^{1-\sigma} * \frac{y_j}{y^w} \right)^{1/(1-\sigma)}$$

and:

$$P_j = \left(\sum_i \left(\frac{p_i * t_{ij}}{\Pi_i} \right)^{1-\sigma} * \frac{y_i}{y^w} \right)^{1/(1-\sigma)}$$

$$x_{ij} = \frac{y_i * y_j}{y^w} \left(\frac{p_i * t_{ij}}{\Pi_i * P_j} \right)^{1-\sigma}$$

Accessibility and economic theory

- Analogy between double constrained discrete choice model of transport and CES trade models:

Traffic flows:

$$T_{ij} = O_i * D_j * A_i * B_j * e^{-\lambda * c_{ij}}$$

With :

$$A_i = \left(\sum_j B_j * D_j * e^{-\lambda * c_{ij}} \right)^{-1}$$

$$B_j = \left(\sum_i A_i * O_i * e^{-\lambda * c_{ij}} \right)^{-1}$$

Trade between countries

$$x_{ij} = \frac{y_i * y_j}{y^w} \left(\frac{p_i * t_{ij}}{\Pi_i * P_j} \right)^{1-\sigma}$$

With:

$$\Pi_i = \left(\sum_j \left(\frac{p_i * t_{ij}}{P_j} \right)^{1-\sigma} * \frac{y_j}{y^w} \right)^{1/(1-\sigma)}$$

and:

$$P_j = \left(\sum_i \left(\frac{p_i * t_{ij}}{\Pi_i} \right)^{1-\sigma} * \frac{y_i}{y^w} \right)^{1/(1-\sigma)}$$

Accessibility and « augmented » accessibility

- Two main kinds of accessibility indicators:
 - Single constrained Transport accessibility, or nominal Market potential:

$$\sum_j D_j * e^{-\lambda * c_{ij}}$$

- Double constrained model or Real Market Potential:

$$RMP = \Pi_i^{-1} = \left(\sum_j \left(\frac{t_{ij}}{P_j} \right)^{1-\sigma} * \frac{Y_j}{Y^w} \right)^{-1/(1-\sigma)}$$

- With the P_j is defined as (akin to a local industry price index) :

$$P_j = \left(\sum_i \left(\frac{t_{ij}}{\Pi_i} \right)^{1-\sigma} * \frac{Y_i}{Y^w} \right)^{1/(1-\sigma)}$$

- The main difference: Real Market Potential stems from a general equilibrium or double constraints, and contains endogenous variables (as well as the double constrained transport model)

New economic geography (NEG)

- Increasing returns to scale (IRS) for industrial firms (and constant returns to scale for agricultural activities).
- Imperfect competition in industrial firms, following the Dixit and Stiglitz (1977) model of monopolistic competition, by which each firm produce one variety of the differentiated product. (Monopolistic competition, along with some simplification assumptions, imply that firms has the same size and make no profit). When the size of the area changes (for instance through migration), the numbers of firms and goods change accordingly.
- Various assumptions of factor mobility

New economic geography (NEG)

- compared to the basic models using accessibility both in transport and in trade, NEG models are more comprehensive.
- Contrary to transport models, they use general equilibrium modelling.
- Contrary to the usual trade models, they assume imperfect (usually monopolistic) competition and assume more varied production sectors.
- In these models, accessibility intervenes under the name of “Market potential”, and plays an important role.

Accessibility in general

- The uses of accessibility
 - Normative
 - Set an objective (for instance : everybody should be at less than 1 km from a mass transit station).
 - Provide a measure for decision making (equity, efficiency, resilience)
 - Positive:
 - Accessibility as a general statistical information (for instance how many people have access to water supply in developing countries)
 - Accessibility as a tool for explaining economic facts (for instance accessibility is used to explain and predict the location of activities and housing, or to explain the level of agglomeration productivity increase)

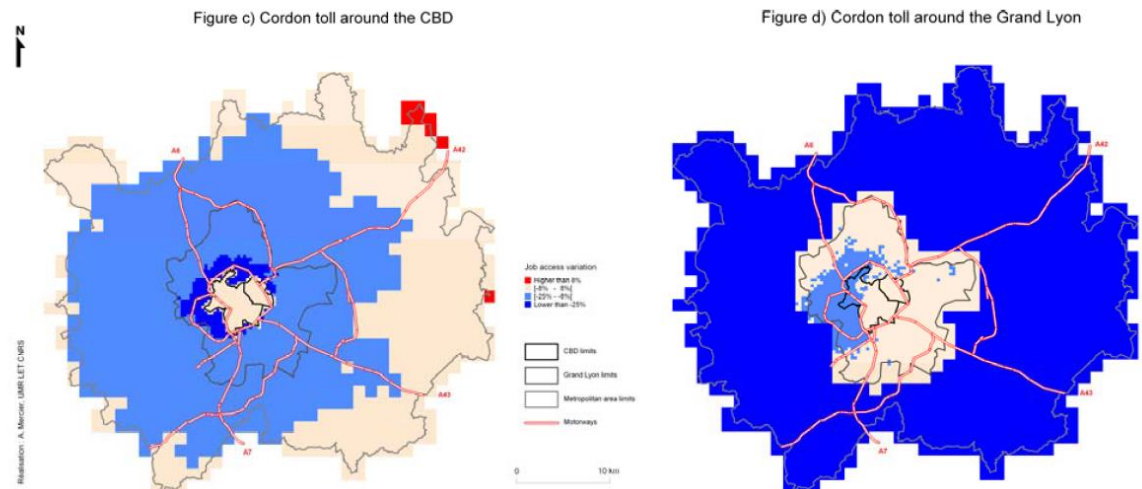
Many normative uses of accessibility are intuitive; for instance as a minimal threshold. It can also be considered as a goal, for instance in the framework of a multi-criteria analysis. Other normative uses are based on economic theory, for instance in the case of transport, through the famous logsum formula.

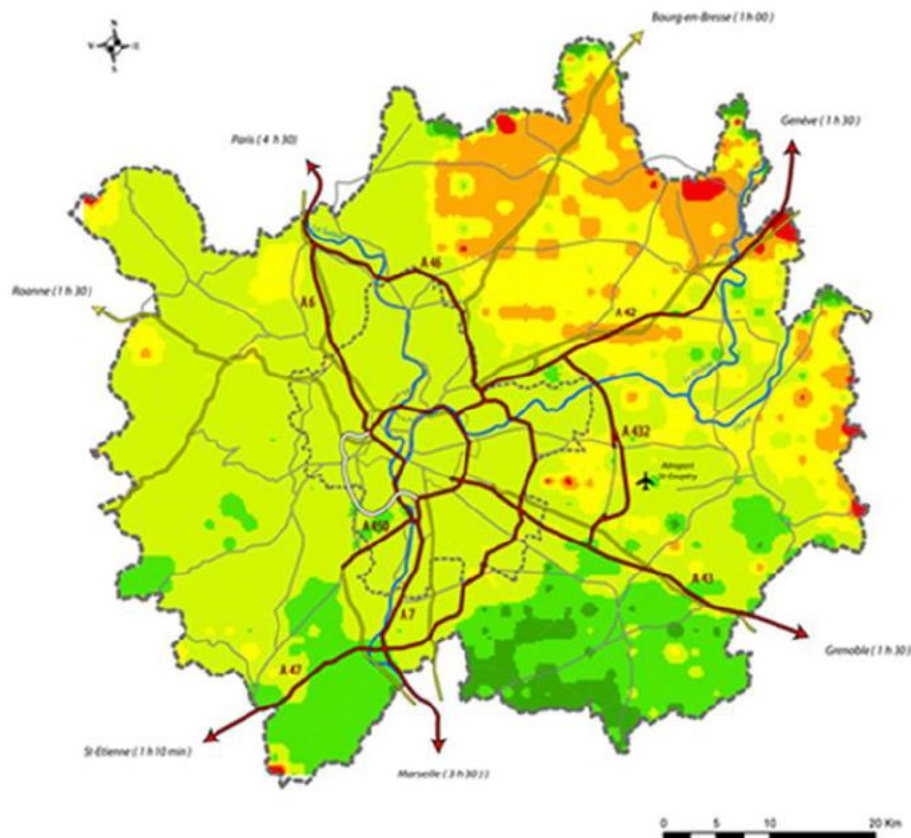
Both normative uses entail drawbacks, due to the fact that the logsum does not represent the collective welfare

THE NORMATIVE USES OF ACCESSIBILITY

« Soft » Normative uses

- The uses of accessibility
 - Normative
 - A threshold (for instance : everybody should be at less than 1 km from a mass transit station).
 - Criterion for decision making (equity, efficiency, resilience)





Légende

Éléments administratifs

- Limites communales
- Limites de l'aire urbaine
- Limites du grand Lyon
- Limites de Lyon Villeurbaine

Réseau routier

- Autoroutes
- TOP
- Routes Nationales
- Routes Principales

Variation d'Accessibilité

(en % de la valeur absolue)

- | | | |
|--|-------------------|----------------------------|
| | De - 100 à - 25 % |] Perte
d'accessibilité |
| | De - 25 à - 10 % | |
| | De - 10 à 0 % | |
| | De 0 à 10 % |] Gain
d'accessibilité |
| | De 10 à 25 % | |
| | De 25 à 100 % | |

« Hard » normative uses: Accessibility as a measure of welfare

- In transport, the logsum, already seen:

$$CS = \frac{1}{\lambda} \left\{ \text{Log} \left[\sum_j \exp(w_j^k) \right] \right\}_{k=1}^{k=2}$$

- In trade, more varied results,
 - welfare is inverse of the price index:

$$\frac{\Delta W_j}{W_j} = \frac{\Delta \left(\frac{Y_j}{P_j} \right)}{\left(\frac{Y_j}{P_j} \right)} = - \frac{\Delta P_j}{P_j}$$

- With :
$$P_j = \left(\sum_i \left(\frac{P_i * t_{ij}}{\Pi_i} \right)^{1-\sigma} * \frac{Y_i}{Y^w} \right)^{1/(1-\sigma)}$$

- Another model (Redding and Turner), allowing for migrations:

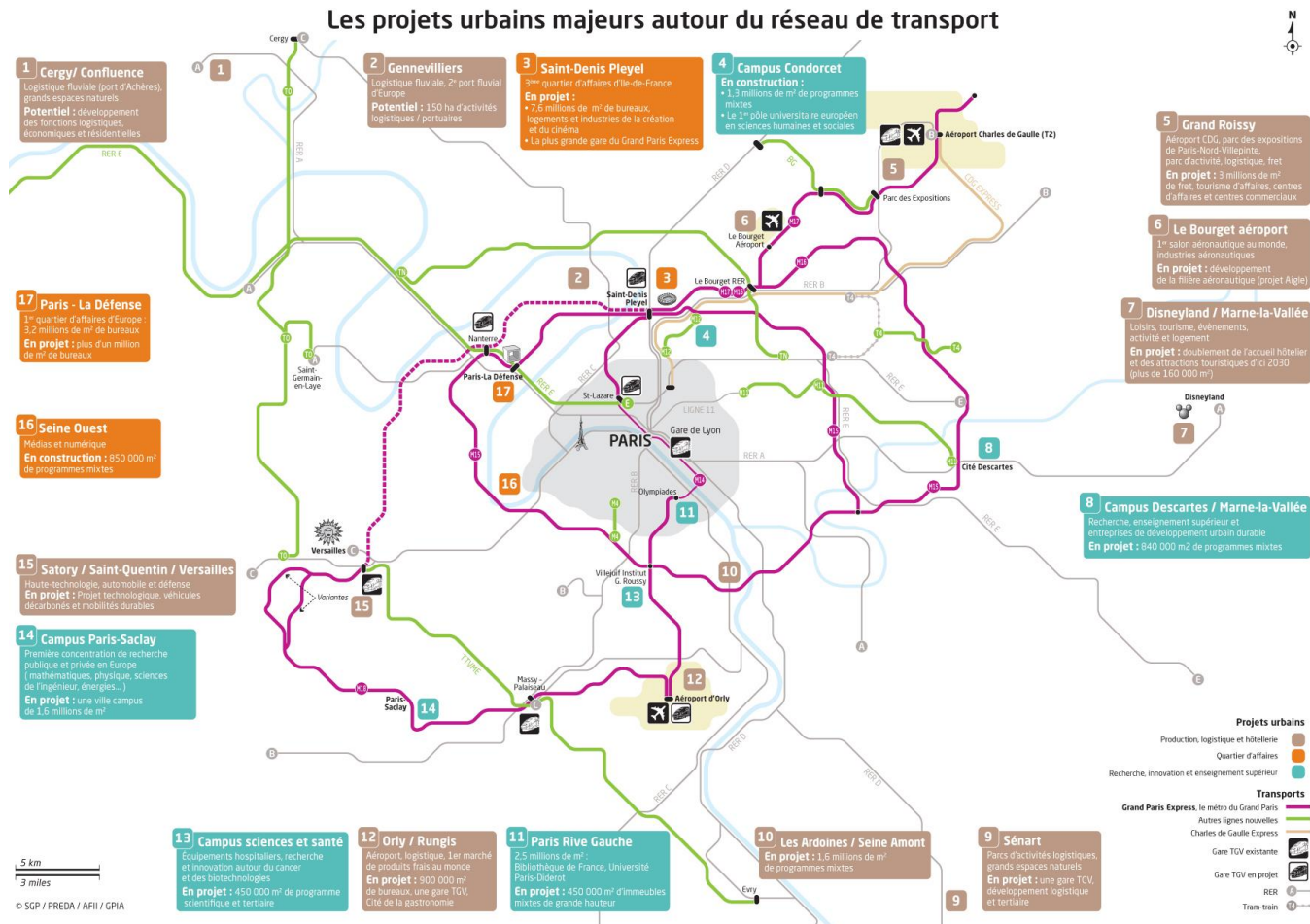
$$\frac{W_1}{W_0} = \left(\frac{\pi_0}{\pi_1} \right)^{\frac{\mu}{\sigma-1}} * \left(\frac{L_0}{L_1} \right)^{\frac{\sigma(1-\mu)-1}{\sigma-1}}$$

- Π is the share of home production

« Hard » normative uses: Accessibility as a measure of welfare

- Issues:
 - In transport, limiting assumptions:
 - Constant income utility
 - No market imperfections
 - In trade, less restrictions
 - Valid through monopolistic competition
 - Main mechanisms ignored:
 - Agglomeration externalities
 - Endogenous growth
 - Labour market imperfections
 - Migrations of firms and households, spatial distribution of effects
- For a better knowledge of how they work, necessary to use positive economics

Focus on the « Grand Paris Express »



Focus on the Grand Paris Express

- The project
 - 200 km long (an increase of 50% of the total mass transit length)
 - Speed: 60 Km/h (instead of 20 Km/h)
 - More reliability
 - Increased frequency (1 train every 80 sec)
 - Cost : about 30 billion Euro

Focus on the Grand Paris Express

- The objectives of the project
 - Improve transportation of course
- But also a part of a plan to revitalise the agglomeration
 - To foster economic growth of the Region
 - Developing high tech (research center, universities, start ups) and business centers (Orly, Roissy, La Défense)
 - Improving the housing market
 - To alleviate the geographical mismatch
 - And improving transportation

Focus on the Grand Paris Express

Benefits	Central scenario (Md€2010)		
	2025	2035	Discounted total amount at year 2010
time savings	1,0	1,9	27,6
Reliability	0,2	0,2	3,4
Comfort	0,1	0,2	2,2
Environment and urban cost effects	0,5	0,7	10,4
Effects of relocated employments inside Ile de France	0,0	0,5	5,5
Pure density effects	0,0	0,6	6,3
New employment effects	0,0	1,1	12,2
Total benefits	1,7	5,1	67,6

Looking for explanations of the mechanisms underlying AE/WEB, it appears that these mechanisms, at least those with a spatial component, are explained by parameters akin to accessibility indexes. But using the results of research for decisions raises several issues

THE POSITIVE USES OF ACCESSIBILITY: THEORY VERSUS PRACTICE

Accessibility and positive economics

- Accessibility is a major indicator for location of firms and households in GEM (LUTI) :
 - It seems that many models imply the same location patterns (to check)
 - Polarisation effects
- But:
 - General interdependences; the three-body problem
- Accessibility is a key factor used for structural models and basic mechanisms' explanation; examples:
 - Agglomeration externalities
 - Wage equation
 - Location effects

Accessibility and agglomeration externalities

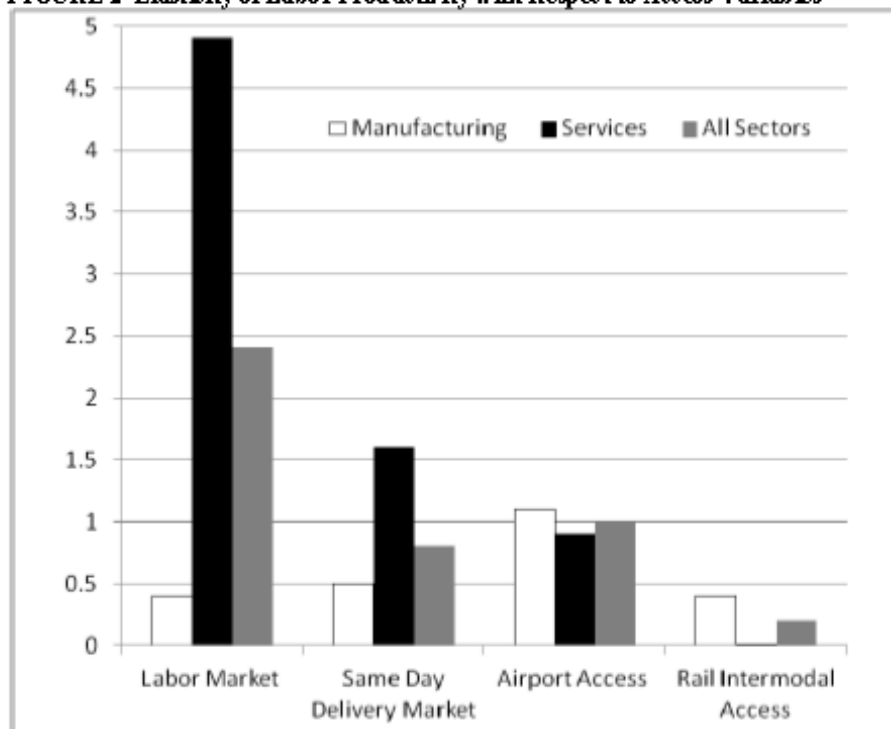
- When activities are close, production is more efficient:
 - Matching, learning, sharing
 - Elasticity of productivity: between 2% and 5%
 - Issues in using research results:
 - Which factor? effective density better than real density
 - How effective density changes when transport cost changes? Elasticity is not a sufficient summary
 - Is there double counting with usual consumers' surplus?
 - What is the final effect once changes in locations are achieved?
 - **And can we define / is there a « final distribution » ?**

Accessibility and agglomeration externalities

Alstadt, Weisbrod and Cutler

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FIGURE 2 Elasticity of Labor Productivity with Respect to Access Variables

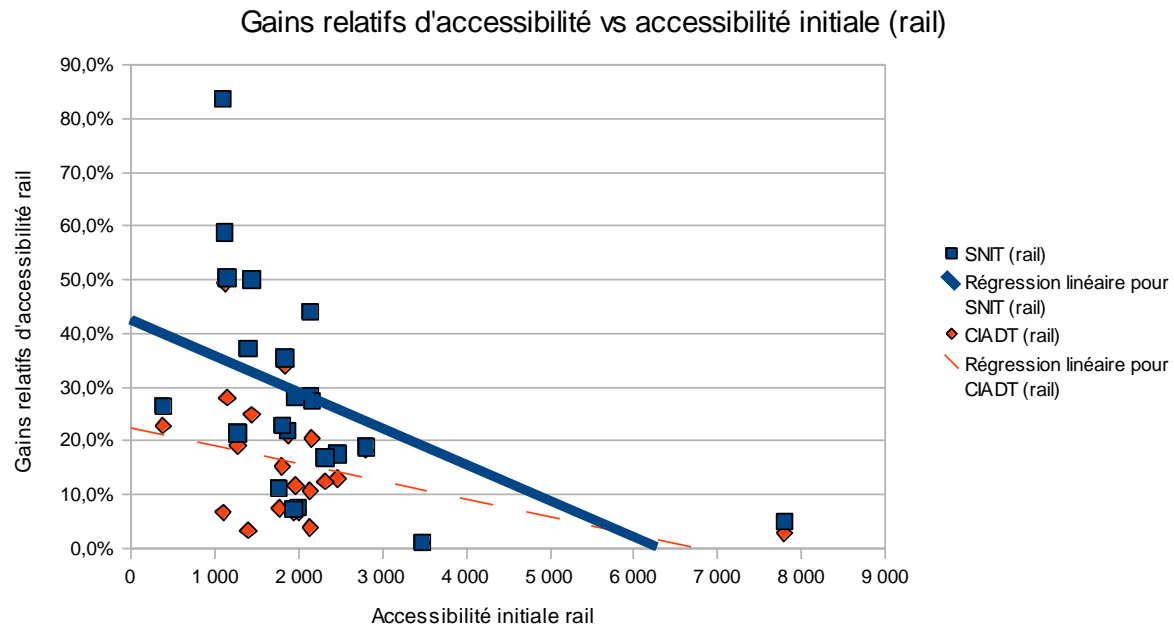
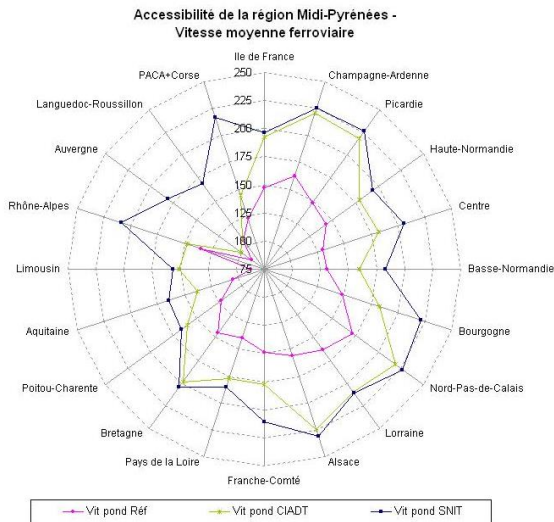


Accessibility and agglomeration externalities

- In terms of growth:
 - Various mechanisms (endogenous growth, imperfect markets) can cause growth as well as AE
 - A conjecture:
 - AE are the best estimated, provide an inferior bound of the effects on top of classical CBA results
 - The sum of the other effects are certainly an upper bound

Examples of practical positive uses

- National level : SNIT



COMPARISONS OF TRANSPORT/TRADE/ NEG AND RELEVANCE FOR PUBLIC POLICY ISSUES

Comparisons

- Transport / 4 step models focus on the impact of costs (c_{ij}) on modal shares and traffic on the links of the networks.
- Trade models often focus on the impact of costs (c_{ij}) on monetary exchange flows between countries or regions.
- NEG encompasses a broader view, where the “size” of the costs (rate of erosion, in the case of iceberg costs) still has a key role, for both the global economic outcome and its repartition between the nodes (cities/territories).
- Anyway, costs of interaction between the nodes are usually the key “control variable” where action is considered and its impacts analysed in the 3 fields

Comparisons

- 4 step models : “micro” and transport
- Trade models : macro / €
- NEG : meso / more distributive analyses
- But this is also at a rather aggregate level, and NEG tools are somewhat complex and not necessarily “user friendly” for local representatives, although useful advice (ex: more accessibility does not necessarily mean more activity)

Comparisons

- From a public policy point of view, policies other than transport where (public) action may take place focus more on the “interaction potential” available at the nodes (O_i and/or D_j , ie population, jobs, shops, etc) :
 - investing in a new facility in location i ?
 - regrouping small facilities in one location ?
 - locating new housing in j ? etc

Comparisons

- Territories in search of “attractiveness”:
 - may relate to D_i or O_i (attractiveness for commerce of goods or amenities available locally; attractiveness for home searching households)
 - or to the accessibility indexes themselves, which take into account the local territory considered within its surrounding (connectivity “advantage” of small cities?)
 - competition issue (or “survival”)

Transversal uses of accessibility?

- accessibility indexes may offer a simple tool for transport and other policies to discuss determinants or outcomes of their respective actions.
- may give some “common basic words” for improving communication between transport and the diverse public policies at a local level.
- Along time, might offer a basis for the development of a commonly shared evaluation framework useful for local diagnosis + discussing strategic investments transversally
- could begin with ex-post analysis ie shared REX // actual outcomes of projects (even counter-intuitive) and continue with prospective studies: our societies and territories are confronted with many rapid evolutions, which may impact most or all areas of public decisions.

Transversal uses of accessibility?

- Besides sectorial prospective studies, transversal studies could take advantage of the framework offered by accessibility analyses.
- Sketching an example: ICT are potentially (and more and more in practice) impacting transport, for instance by the surge of new mobility vectors or new ways of using traditional vectors.
- It directly impacts the transport cost terms c_{ij} , but on the long term, due to impact on transport costs, it may impact the location of goods, services and populations ie the O_i and D_j terms. But the same technologies impact also directly the O_i and D_j , for instance internet sales compete with physical shops. They also lower the friction costs involved in getting a good from territory i from territory j , besides transport costs
- But diverse types of interactions, for many physical issues proximity remains key factor; ex: start ups close to/in universities ; limits of teleworking

How could we implement this kind of ideas in practice?

- Try to improve link between research results and decision: a programme to assess the use of accessibility as a proxy for a rough (but hopefully often sufficient?) way to cope with market imperfections / to estimate distribution + location effects
- would not be a simple survey of research, goal would be to better address decision makers' needs for « useful » information: orders of magnitude of « observed impacts (« mean » + « range ») »

Suggestions for the way forward

- estimating the magnitude of the effects of accessibilities changes on variables of interest in various situation:
 - Through econometric analyses, ex post studies, GEM
 - With the cooperation of researchers and practitioners
- Deducing from them a typology of “commonly observed” elasticities, transfer values, basic parameters
- Thus obtaining results informative for decision-making,
 - Which would be perhaps less informative and less theoretically justified than NEG / GEM
 - But much less costly, less time consuming, more accessible to decision-makers (usual caution// misinterpretation / manipulation) and less data demanding (... and less subject to uncertainty??)

Thanks for your attention ...

Accessibility Statistics

- The diversity of practices
 - Either regularly updated indicators published as open statistics
 - UK, USA France
 - Used as informations for decision makers, but without guides on how to use these indicators
 - Or indicators specially reckoned for specific projects or programmes and included in a kind of MCA
 - France
 - The case of international organizations:
 - WB
 - EU
- Criteria for designing indicators:
 - Ease of implementation, availability of data
 - Communicability
 - Sensitivity of the results
 - Experience

The UK: from social purposes to transport efficiency

- Ancient indicators:

	Definition	Example
Threshold indicators		
Destination indicators	The proportion of users in a local area who can access a service within pre-set time limits	The percentage of 5-10 years old who can get to the nearest primary school by public transport or by walking less than 15 minutes
Origin indicators	The number of services accessible within pre-set limits to users of an area	The number of primary school less than 15 mn away by public transport or walking
Continuous indicators	This measure is based on the sensitivity of users to the travel time for each service, i.e. the longer it takes to get to a particular service, the fewer people will go	
Destination indicators	The number of services accessible to users of an area within pre-set time limits	
Origin indicators	The number of primary schools accessible by public transport or walking	

- New ones:

Destination type	Used for weighted travel time measure (see section 4)	Shown in Excel data tables (and used for other measures)	Available in the raw dataset
<i>Airports</i>	32 / 33 airports in GB	32 / 33 airports in GB (with different terminals for the larger airports shown separately)	32 / 33 airports in GB (with different terminals for the larger airports)
<i>Stations</i>	All A and most B category stations	All A and most B category stations	All A, B and C1 category stations
<i>Road junctions</i>	122 junctions on the SNCs and SRN	122 junctions on the SNCs and SRN	492 junctions on the SNCs and PRN

US Federal : key nodes for long distance transport

- Connectivity:

	48 states			Alaska / Hawaii			50 state total		
	Total terminals	With connections	Percent	Total terminals	With connections	Percent	Total terminals	With connections	Percent
Intercity rail stations	505	274	54.3%	22	6	27.3%	527	280	53.1%
Airports	434	148	34.1%	237	11	4.6%	671	159	23.7%
Ferry terminals	254	111	43.7%	42	10	23.8%	296	121	40.9%
Total	1,193	533	44.7%	301	27	9.0%	1,494	560	37.5%

NOTE: The terminals shown in this chart represent those that have been included in the Intermodal Passenger Connectivity Database as of December 2008. Some data have been updated and may differ from that in BTS Special Report SR-004, issued in September 2007. Data for rail transit and intercity bus will be added in future Special Reports.

SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Intermodal Passenger Connectivity Database as of December 2008.

France: focus on spatial equity and
quality of service

ONU : poverty of less developed populations

- An array of urban poverty indicators

Affordability of Mobility	1. Percentage of the poorest 10% in the city for whom a urban transport system is affordable (requiring less than 10% of monthly household expenditure) (STEP 7)
Availability of Urban Mobility	2. Percentage of the population who can access to key services in 30 minutes from your home for different social groups and different times of day/night (STEP 5 & STEP 6) 3. Distance travel to reach nearest bus stop (km/miles) (STEP 2 &STEP 5) 4. Average waiting time at bus stops (minutes / hours) for different time of day and for different social groups (men, women, children and older people) (STEP 4) 5. Average frequency of buses serving the same route (minutes/hours) for different times of day & night (STEP 4)
Acceptability of Urban Mobility	6. Average ratio of the number of passenger to vehicle capacity by different times of day/night (STEP 3) 7. Percentage of services that terminate early by different times of day or night (STEP 3) 8. Average additional cost to passenger of travelling with loads (STEP 5 & STEP 7) 9. Is it safe to walk around a neighbourhood (YES/NO) for different social group and for different time of day and night (STEP 5 & STEP 6)

Accessibility and economic theory

- The Transport tradition : discrete choices models for traffic modeling and welfare:
 - RUM: indirect utility of agent i for good j is:

$$V_{ij} = \bar{V}_i + U_{ij} + \varepsilon_{ij}$$

- With the complementary assumption that ε_{ij} follows a Gumbel pdf, the proportion of j choice is:

$$P_{ij} = \frac{e^{\lambda_i * U_{ij}}}{\sum_j e^{\lambda_i * U_{ij}}}$$

- And the surplus of the agent is the logsum:

$$S_i = \frac{1}{\lambda_i} \log \left[\sum_j e^{\lambda_i * U_{ij}} \right]$$

Accessibility and economic theory

- The discrete choice model and welfare:
 - Introducing the number of people O_i with the same purposes of origin i :
 - We get an avatar of the gravity formula, the single constrained model:

$$T_{ij} = O_i * \frac{D_j * e^{-\lambda * c_{ij}}}{\sum_j D_j * e^{-\lambda * c_{ij}}}$$

- Assuming these agents have the same utility function, their surplus is:

$$S = \sum_i S_i = O_i * \log \left[\sum_j D_j * e^{-\lambda * c_{ij}} \right]$$

Accessibility is omni-present in transport and trade

- For instance:
 - Labour market
 - Agglomeration externalities
 - Location of productive activities and housing
 - Dependency of regional wages on accessibility
 - Migrations
- Accessibility is a major factor for location of firms and households in GEM
- Accessibility is closely linked to welfare

Accessibility and economic theory

- The Trade and space economy tradition for flow modeling (and welfare)
 - The gravity model
 - Many possible theoretical derivations

The accessibility indicators used in mechanisms

- Two main kinds of accessibility indicators:
 - Transport accessibility, or nominal Market potential, used in transport:

$$\sum_j D_j * e^{-\lambda * c_{ij}}$$

- Index of Real Market Potential, widely used in spatial economics:

$$RMP = \Pi_i^{-1} = \left(\sum_j \left(\frac{t_{ij}}{P_j} \right)^{1-\sigma} * \frac{Y_j}{Y^w} \right)^{-1/(1-\sigma)}$$

- Where the P_j is defined as (akin to a local industry price index) :

$$P_j = \left(\sum_i \left(\frac{t_{ij}}{\Pi_i} \right)^{1-\sigma} * \frac{Y_i}{Y^w} \right)^{1/(1-\sigma)}$$

The wage equation

- A workhorse of NEG.
- Example of Puga model (monopolistic competition, CES utility):

- Symbols:

- Region i
- Number of workers: L
- Immobile capital (land): K
- Price index: q
- E : income of region

$$q_i = \frac{\sigma\beta}{\sigma-1} \left(\frac{1}{\alpha\sigma(1-\mu)} \sum_j (\zeta_j L_j q_j^{-\mu\sigma} w_j^{1-\sigma(1-\mu)} \tau_{ij}^{1-\sigma}) \right)^{1/(1-\sigma)}$$

$$w_i = \left(\frac{\sigma\beta}{\sigma-1} \right)^{\mu-1} q_i^{\mu/(\mu-1)} \left(\frac{\beta}{\alpha(\sigma-1)} \sum_j e_j q_j^{\sigma-1} \tau_{ij}^{1-\sigma} \right)^{1/(\sigma(1-\mu))}$$

- Two versions: either no migrations, or perfect migrations (wages are equalized between regions)

The wage equation

- WE is apparently similar to the AE
- But:
 - WE results from a general equilibrium framework, while AE is based on more simple assumptions (firms minimize costs)
 - AE can be explained by several mechanisms: learning, matching, sharing; while WE does not imply learning.
 - AE does not imply anything about migrations, while WE can be coupled with migrations assumptions

Comparisons

- 4 step models developed and primarily focused on predicting the evolution of flows (and congestion) on the transport network, from a sectorial and technical point of view : “micro” and transport
- Trade models concentrate on monetary flows on a rather aggregate level, which does not correspond either to the local policies’ concerns. : macro / €
- NEG explicitly analyses the distribution of outcomes for the territories: in this regard it is closer to the local policies’ concerns : meso
- But this is also at a rather aggregate level, and NEG tools are somewhat complex and not necessarily “user friendly” for local representatives.

Towards a research/study programme to assess the use of accessibility as a proxy for a rough, but often sufficient, way to cope with the market imperfections and to estimate distribution and location effects. This program would not be a simple survey of research, but strictly decision-oriented

TOWARDS A PROGRAMME TO LINK RESEARCH RESULTS AND DECISION