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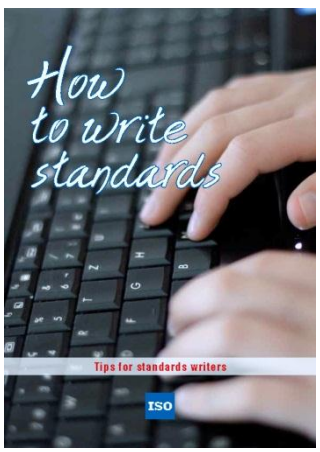

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Foreword

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The committee responsible for this document is ISO/JTC 1.

ADD INFORMATION ABOUT REPLACED STANDARDS AND OTHER PARTS AS NECESSARY

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Introduction

The purpose of this international standard, Smart City ICT Reference Framework, is to assist city Chief Information Officer (CIO) and other stakeholders in planning and implementing a smart city. It comprise the following three parts:

- Part 1: Smart City Business Process Framework
- Part 2: Smart City Knowledge Management Framework
- Part 3: Smart City Engineering Framework

These three views are each aimed at a different role or viewpoint within the city and thus separate focus needs to be maintained. The "separation of concerns" is a principle for development of system architecture as a set of views. The value of using the separation of concerns is to simplify development and maintenance of the architecture.

The Smart City Knowledge Management Framework is principally a tool for data managers within the key agencies within the city. It also address needs of service managers and strategic managers within the city, because it underpin and improve data and information sharing, collaboration and consultation.

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Information technology— Smart City ICT Reference Framework— Part 2: Smart City Knowledge Management Framework

1 Scope

The scope of this standard is to define a generic Knowledge Managment Framework for a smart city. This standard will thus focus on smart city specific processes. and practices.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO #####-#:20##, *General title — Part #: Title of part*

3 Terms and definitions

3.1
term
text of the definition

Note 1 to entry: Text of the note.

3.2
term
text of the definition

4 Modeling Formalism

Editor (FC) note: We need to specify the formalism and convention used in this document. Recommendation: align to the ITU M3050 (eTOM) documents.

5 Smart city knowledge Management

5.1 Aims and scope

This is a model that would be useful to several stakeholder groups including a city Chief Knowledge Officer, where such a post exists, or otherwise the group of data managers within the key agencies within the city. It would also be useful to service managers and strategic managers within the city, because it could underpin and improve data and information sharing, collaboration and consultation.

It cover four key types of insight that are necessary when sharing data in a city:

- Operational insight – which examines characteristics of things such as buildings, communities and organizations, using data to evidence and improve their value for the city;
- Critical insight – the real-time monitoring of incidents and current cases, involving all relevant organizations from across sectors, who work together to achieve the desired outcome or response;

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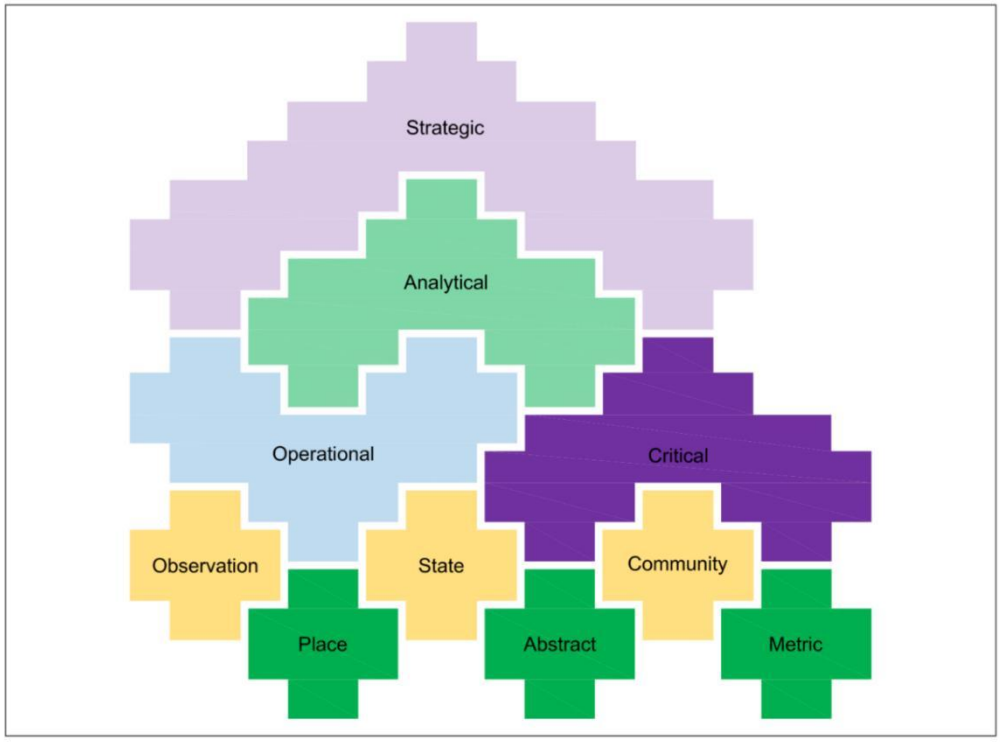
- Analytical insight – the exploration of the data ecosystem to determine patterns, correlations and predictions. This allows the development or innovation of systems or services, impact assessment of proposed changes to systems or services, or the evidencing of challenges and opportunities for the city; and

- Strategic insight – an overarching approach that examines outcomes related to strategic objectives, decisions and plans.



. Figure 5-2 From PAS 182

It reflect barriers to data interoperability.

Barrier	Description
Privacy	Conforming to human rights and data protection requirements when handling data that refers to people.
Security	Protecting data from accidental or malicious destruction, or unauthorized access.
Integrity	Avoiding data corruption as data is handled, copied, processed, and transported.
Quality	Characteristics of data such as completeness, validity, consistency, timeliness, accuracy, precision, and tolerance. It is important to understand the quality of data when considering if it can be reused for a new purpose
Provenance	The traceability of data, from collection, through each transformation, analyses and interpretation.

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6 An upper level ontology for Smart Cities – the platform for a key programme of work

6.1 Introduction - The problem to be solved

A key challenge of managing a city as an integrated whole is that the services offered to citizens, visitors and businesses etc. are delivered by a wide variety of agencies within many different city systems. Each of these organisations have their own objectives and perspectives on city life, and each of these systems work fairly autonomously from the others and have developed their own vocabularies and management processes.

In order for the city to work effectively, its organizations and citizens need to be able to share data. At an operational level, this is vital to allow the interoperation of their component systems, and at a strategic level, the sharing of data is needed to evidence the effective use of resources to bring about beneficial change.

However, city data is often labelled using the language and terms from the sector that initially collected it. Each sector has its own models and terminologies that enable data to be discovered and understood within that sector, but form a barrier to interoperability with other sectors.

In theory, the best approach to achieve interoperability is to force all sectors to adopt the same vocabularies, but in practice this is impossible. The alternative is to use ontology mediation approaches for data discovery and data access across these heterogeneous data models. This requires an upper level ontology for the city to be agreed, which can describe a set of fundamental concepts and relationships to which the specialist terms and vocabularies developed within individual city systems can be mapped.

6.2 Examples of existing upper level ontologies and their use

Here is the set of concepts for the City Conceptual Model developed by Peking University, for example:

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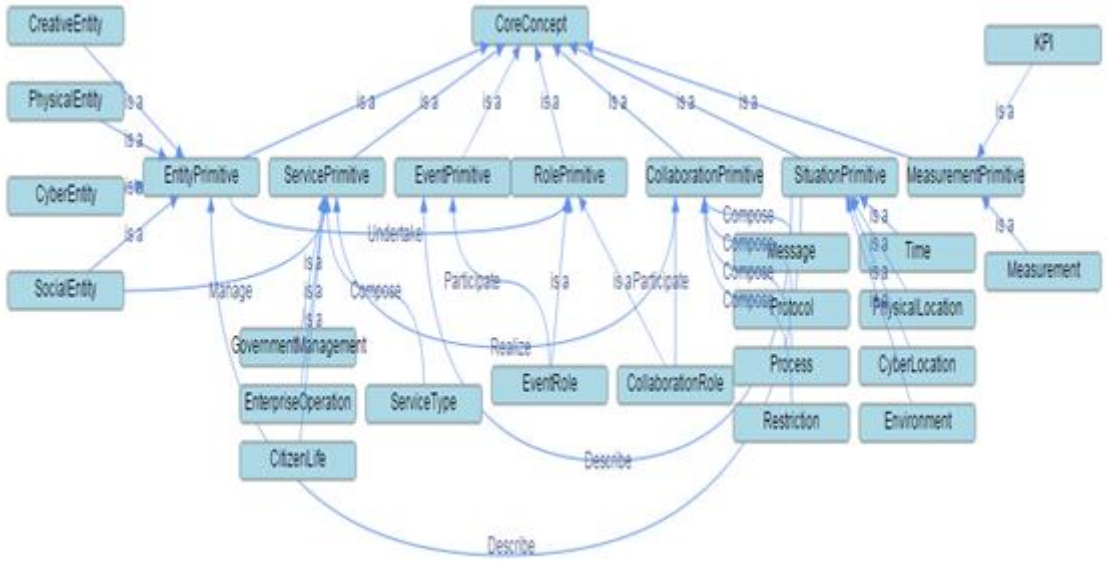
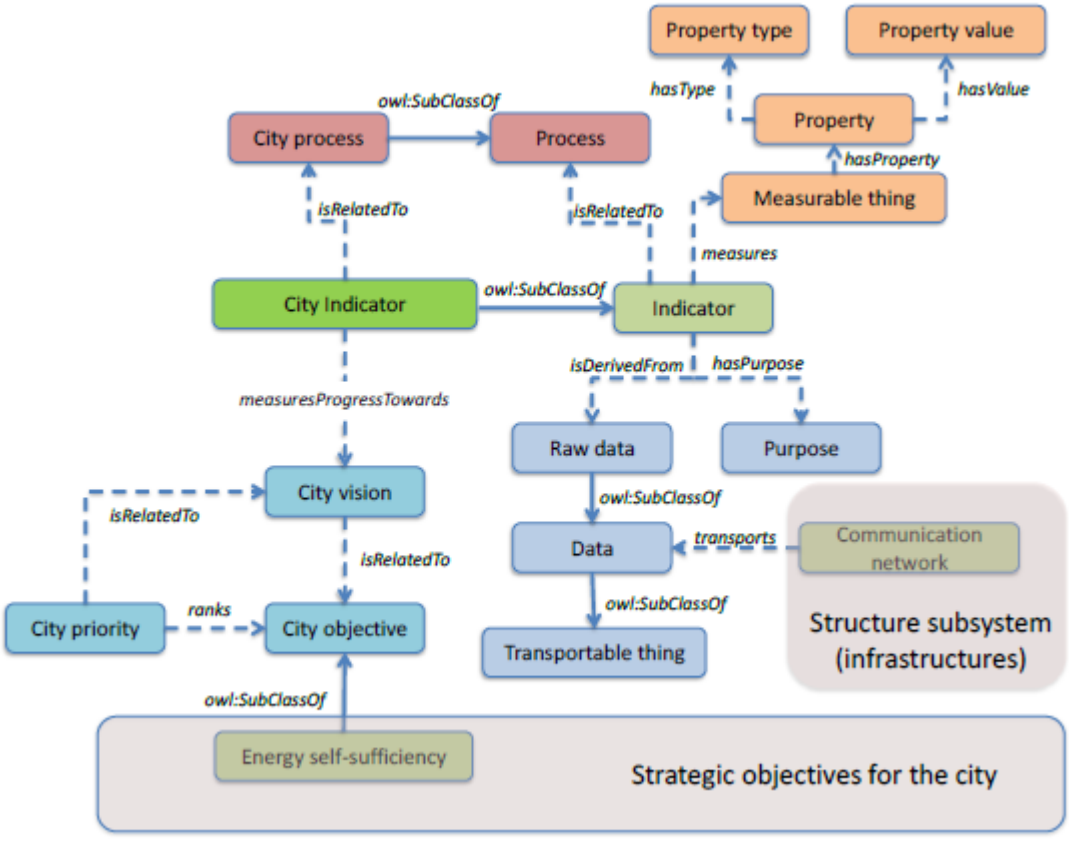


Figure 6-1 City Conceptual Model

The City Protocol Society has developed an ontology for representing high level city concepts from a



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systems perspective, including processes and indicators.

Figure 6-2 The City Protocol Society

The Global City Indicator Foundation Ontology2 provides the high level concepts for the representation of meta-data that should be associated with all data gathered by a city. This includes: units of measure, provenance, validity and trust.

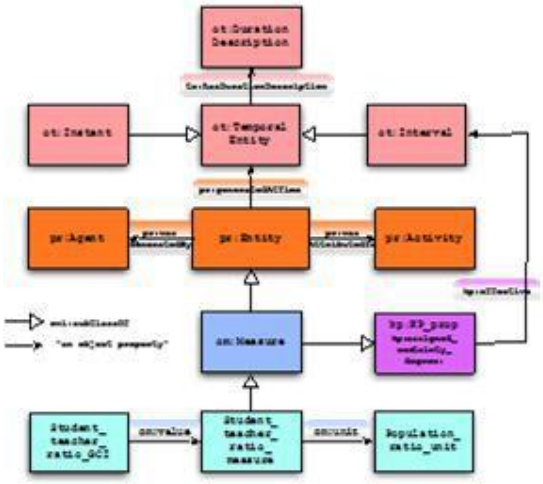

Figure 6-3 The GCI Foundation Ontology

[2] Fox, M.S., (2013), ―A Foundation Ontology for Global City Indicators‖, Working Paper No. 3, Global Cities Institute, University of Toronto, Revised 12 April 2015. http://eil.utoronto.ca/wp-content/uploads/smartcities/papers/GCI-Foundation-Ontology.pdf

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The British Standards Institution‘s PAS 182 defines 27 high level concepts and their relationships with each other. Below is an illustration of the relationships between some of these concepts to the concept ―item‖ as an example.

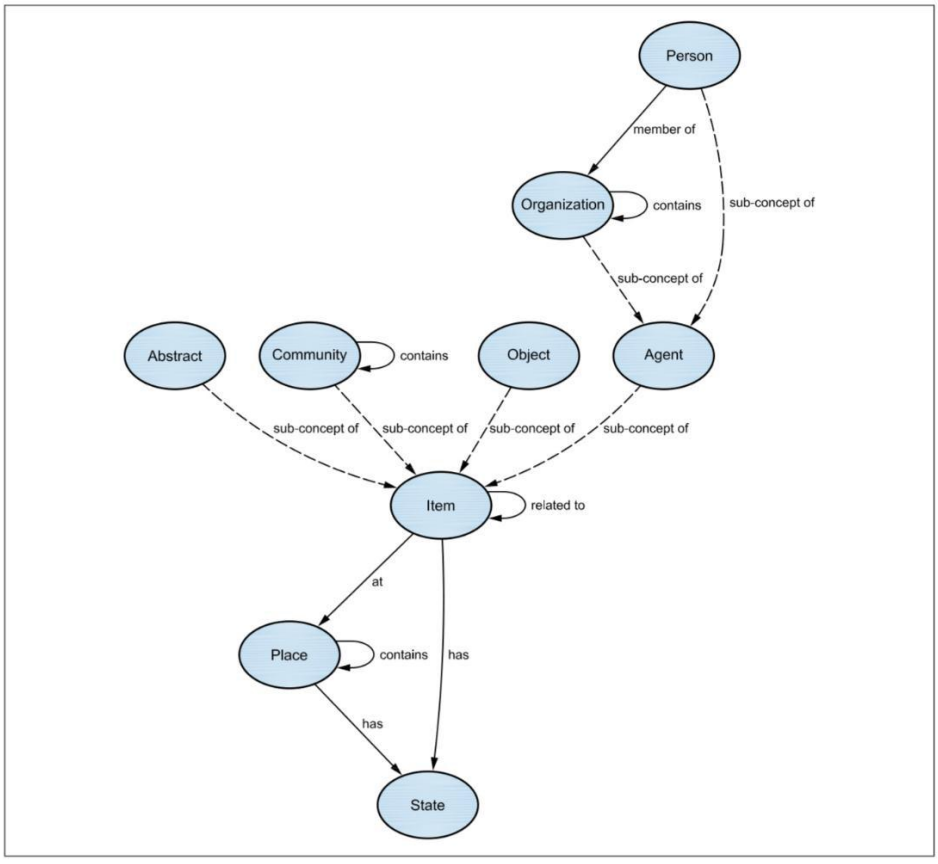

Figure 6-4 Smart City Concept Model

The more detailed and specific concepts within sector specific ontologies can then be mapped to these upper level concepts. Below are some examples of how concepts within the UK Health informatics concept model can be mapped to the PAS 182 Smart City Concept Model.

Health informatics concept model	**Definition**	**Smart City Concept Model**
subject of care	healthcare actor with a person role; who seeks to receive, is receiving, or has received healthcare	PERSON

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demand for care	demand for healthcare provider activities expressed by a healthcare actor	EVENT
health condition	observed or potential observable aspects of the health state at a given time	STATE
healthcare provider	healthcare actor that is able to be assigned one or more care period mandates	AGENT

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episode of care	health related period during which healthcare activities are performed to address one health issue as identified by one healthcare professional	CASE
healthcare treatment	healthcare activity element intended to directly improve or maintain a health state	EVENT
point of care	location where direct healthcare activities are performed	PLACE
healthcare funds	resource provided for funding healthcare delivery	RESOURCE
protocol	customized clinical guidelines	RULE
clinical pathway	pathway for the healthcare activities informing the content of core care plans	METHOD
health record	data repository regarding the health and healthcare of a subject of care	ACCOUNT

A similar process could be undertaken to map terms in other sector specific ontologies to such an upper level set of concepts, to allow information to be more easily shared between sectors and organisations within the city.

6.3 Review of existing work

BSI have indicated that they wish to submit their existing national standard, PAS 182 – —Smart City Concept Model – to JTC 1 for fast track into an international standard.

The contribution from China provided to the Study Group as document N 110, also provides some useful ideas and structure for such a new work item and provides some links with the next level down.

The City Protocol Society extends these ontologies to include city systems, processes and indicators.

Furthermore, although not working explicitly in the domain of smart cities. ISO TC268 is evolving work in this area and the recent ballot of DTR 37102 will provide a further —building block‖ with a common vocabulary for sustainable communities.

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6.4 The recommendation – develop an upper level ontology for smart cities

It is therefore recommended that work would begin by defining a high level, overarching framework of smart city concepts and relationships that can be used to describe data from any sector and thus mediate between the different sector-specific ontologies. Mapping terms from many sectors to such a common concept ontology would provide a basis for discovering and sharing data about the same thing, from many sources.

It could be applied to operational, statistical, analytical and strategic data, linked to a city wide set of reference data.

Use of such an upper level ontology for smart cities would enable sectors within a city to collaborate by extending out to create richer classes and attributes.

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6.5 A potential work programme based on the Upper Level Ontology

The value of focusing on a high level set of concepts initially is that it should be comparatively easy to agree on an international basis and this will provide immediate value.

However, once the Upper Level Ontology for Smart Cities is agreed as an international standard, it could also provide the framework for a whole programme of useful international standards work.

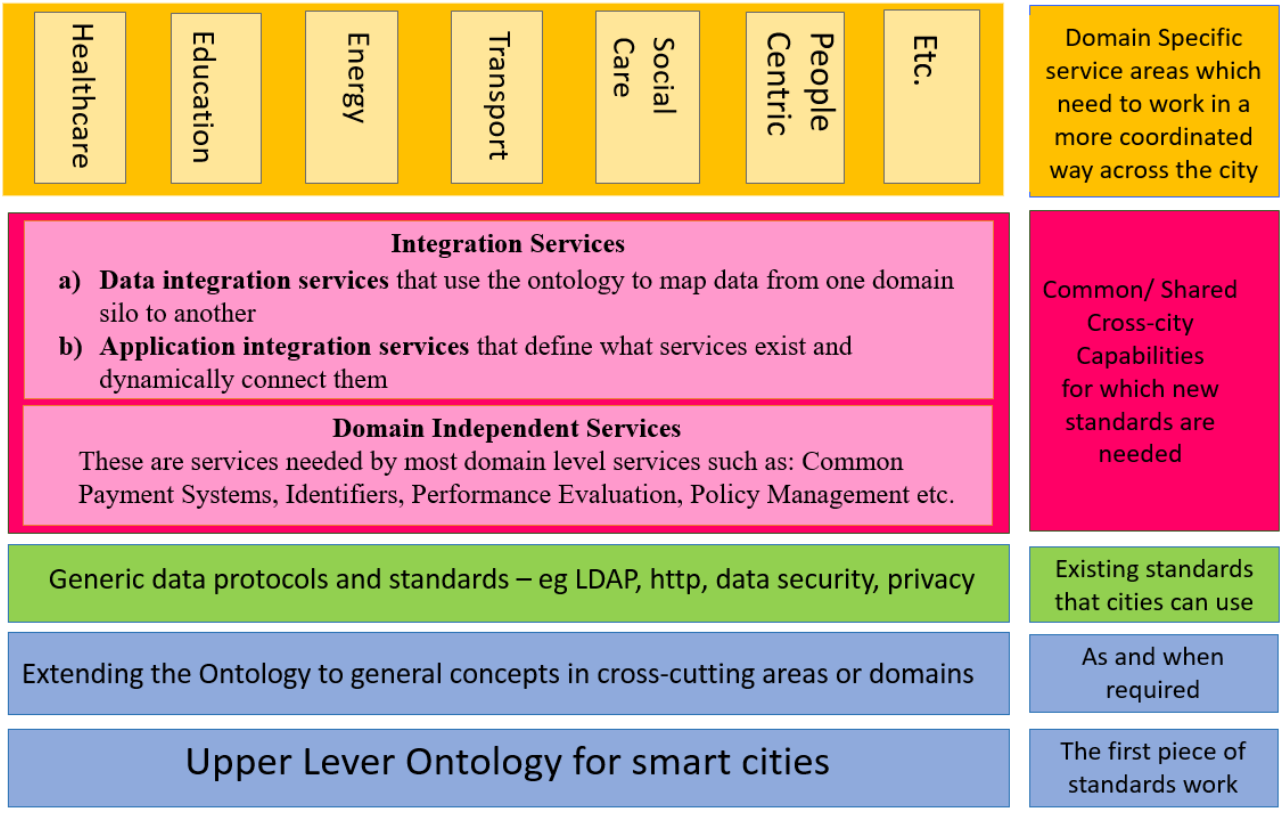

Figure 6-5 Potential program of work based on the Upper Level Ontology

6.5.1 Extending the concepts to further develop the ontology

Once the Upper level ontology for Smart Cities is agreed as an international standard it could be further developed as required. The concepts defined in the ontology could be used as the foundation from which sets of specific _classes‘, _properties‘, identifiers, terms etc. could be

extended. Extensions could be defined for general use, or for use within a sector. For example:

General concepts might be extended by developing a series of classes based on them. For instance, the PLACE concept might be extended with classes such as

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- Point
- Location
- Area
- Administrative Geography
- Conurbation
- Statistical Geography

… and with properties for

- Coordinate Reference System
- Address

And so on.

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The concepts may also be extended into **Individual domains** using specialist terms. For instance, the SERVICE concept might be extended in the Transport sector with classes for

- Bus Service
- Train Service
- Timetable Service

The concept of city metrics/indicators can be extended to include:

- Measurement units
- Provenance
- Validity
- Trust

as demonstrated in the Global City Indicators Ontology developed at the University of Toronto and included in the City Protocol Society ontology.

And so on

6.5.2 Standards for common/shared cross-city capabilities/services

The Upper Level Ontology for Smart Cities could also provide the basis for further standard work to underpin extra key applications. For instance, Peking University and Digital China are developing a people-centric public service ontology model to describe the interfaces and governance of digital services, based on a high level set of concepts related to the city.

A number of countries are also considering the idea of ‗local digital services' in which local and national agencies expose ‗digital capabilities' which can be combined to form an end-2-end digital service, orchestrated over digital participants. Potentially the Upper Level Ontology for Smart Cities could help as the basis of a framework to consistently define APIs across services. With further extension it would be able to describe the governance of digital capabilities.

The UK and other countries are exploring ‗platform services' as implementations of capabilities such as ‗personalisation', ‗identity management', ‗data sharing', ‗data matching', ‗scheduling / booking', ‗personal data stores', ‗performance dashboards', and so on. The Upper Level Ontology for Smart Cities could form the foundation for this important work as well.

In general, we could say that there are two different types of common/shared cross-city capabilities/services for which standards work would be useful

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1. Domain Independent Services that are needed by most domain level services, such as common payment systems, identifiers, performance evaluation, policy management, and so on. Developing an upper level ontology for a city would allow the requirements of the different domains to be described in a domain independent way and thus make it easier to enable them to use the common service.

2. Integration Services, which fall into two types: "data integration" which rely on using the upper level ontology to map data from one domain silo to another, and "application integration services" that define what services exist and dynamically connect them.

6.5.3 The need of a Guidance Document on existing generic data protocols and standards

There are a great many existing standards and protocols relating to the sharing of data. These have been developed by a range of standards organisations and it is therefore not easy for city data practitioners to understand how they can be brought together into an overarching portfolio to enable them to follow best practice.

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The provision of a guidance document for city leaders to guide them through the standards landscape in this area would be very helpful.

6.6 The value of the whole programme of work

It would:

- Allow different city databases to be more easily aggregated to provide greater insight into what is happening in the city
- Make it easier to transform data from reports into machine readable formats
- Support the ease of finding information of common interest held by different stakeholders within the city.
- Support consultations and debate by providing a logical and easy to use framework to manage this.
- Allow city services, particularly digital services, for instance a billing system, to be described in such a way as to enable services designed within one city system to be easily ported across to other systems – and to other cities
- Make it easier to compare cities through benchmarking and support shared learning.

When knowledge is joined, shared and published, based on a common understanding of meaning, and consistent use of identifiers and classifications, cities could experience the following benefits:

- reduced cost, as the need to re-collect and verify data is removed;
- integrated city systems and services driven by data;
- a common understanding of the needs of communities;
- shared objectives, collaboratively developed and evidenced using data;
- engaged and enabled citizens and communities;
- transparency in decision-making;
- development of partnership models;
- businesses and communities co-creating innovation; and
- consequently, improved quality of life for citizens.

Therefore, developing an Upper Level Ontology for Smart Cities as an international standard, would form the foundation for a whole programme of strategically important standards work around smart cities.

6.7 Recommendations

That JTC 1:

1. Develops an *Upper Level Ontology for Smart Cities*

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2. Identifies and develops standards for common/shared cross-city services

3. Develops a Guidance Document for cities on existing standards and protocols relevant to the development of common and shared capabilities for Smart Cities

7 Strategy, Infrastructure

Editor 【JT】-Is this still required?

8 Smart City Data and information sharing, collaboration and consultation

Editor 【JT】-This is PAS 183

9 Use Cases of Smart City Knowledge Management

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Annex A (informative) Smart City Knowledge Management Guiding Principles

A.1 Clause

Type text here - use subclauses if required e.g. A.1.1 or A.1.1.1.

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