

# Smart Territory Analytics: toward a shared vision

## *Smart Territory Analytics: verso un approccio condiviso*

Carlo Giovannella

### **Abstract**

Smart Territory Analytics is a very young domain that by a great number of people is expected to support benchmarking of cities' and territories' *smartness*. Analytics, however, is first of all, a route toward awareness but the question is: about what? In other words what does *smartness* mean? Here, as an example of "wisdom of the crowd" extraction, we report about word frequency analytics applied to open answers given to a questionnaire on Smart Cities. It comes out that the achievement of awareness is a process implying a deeper understanding of the territory and individual perception and, as well, a greater attention to the well being of citizens and the environment they populate, being citizens at the same time the main source and the end-target of the territorial *state of flow*.

**Abstract** L'analisi qualitativa e quantitativa di un territorio "smart" è un dominio di ricerca molto giovane a cui si guarda con interesse nella speranza di arrivare ad un "benchmarking" quanto più oggettivo possibile della *smartness*. Ma quale è il significato di *smartness* ? Al fine di esemplificare un possibile approccio "bottom-up" mirato a fornire una risposta a tale domanda, riportiamo i risultati di un'analisi di frequenza dei termini utilizzati da 434 docenti di scuola media e media superiore nel rispondere a una porzione di questionario sulle Smart City. Tale analisi dimostra come, insieme a una profonda comprensione del territorio, sia importante intercettare il sentire comune e porre maggiore attenzione al benessere sia dei cittadini che dell'ambiente che essi popolano, tenendo a mente che i primi sono sia la principale sorgente che il target finale dello stato di *flow* del territorio.

**Key words: smart territory analytics, territorial smartness, traces, wisdom of the crowd, text analysis, people in places smart cities**

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<sup>1</sup> Carlo Giovannella, ISIM\_garage, STF Dept, University of Rome Tor Vergata and Industrie Creative Consorzio Roma Ricerche; email: giovannella@scuolaiaad.it

## 1 Introduction

Urban agglomerations are complex systems that must continuously attract resources to sustain both their maintenance and their expansion. Among such resources we should include also the human capital (either social and intellectual) [1, 2] that can contribute in a decisive way, actively and creatively, to their development.

Despite the fact that all urban agglomerations are all over the world formidable attractors for people, range and quality of the opportunities that they may offer are believed to be strongly dependent on what is nowadays called *smartness* of the territory. Because of this, since a while, cities have started from one side to be submitted to comparative analysis and from the other to adopt policies aimed at sustaining a competition that, day by day, is becoming increasingly hard. In such situation, it is not strange that many subjects “rushed” to be the first to produce rankings of *cities smartness*. During such rush, however, people did not take time to think over and give a convincing definition of what cities’ smartness is and/or to check if the chosen indicators were statistically reliable and truly suitable to describe it. Actually the most popular approach to benchmarking has been also the most straightforward one: after the identification and the adoption of a well known model of regional development as framework of reference, people has simply integrated in it the benefits that may derive from the settling of ICT (Information and Communication Technology) infrastructures, considered as enablers of intelligent regions [3]. Up to now the most popular definition of Smart City [4], in fact, seems to be: a “city well performing in a forward-looking way in six *smart* characteristics, the so called ‘soft factors’ of the neoclassical theory of regional and urban development: *smart economy*, *smart mobility*, *smart environment*, *smart people*, *smart living*, *smart governance*”. In the recent past, also other models have been used in the attempt to properly benchmark smart cities (like the Triple Helix [5, 6] and three Ts [7]) but, regardless of their appropriateness, their popularity has been, so far, quite limited. As a matter of fact, in a short while, the six-axis model has become the reference to benchmark cities’ smartness (see as examples: Fast company and Smart Cities Wheel [8], iCity rate index [9], etc.). One critical aspect common to all these attempts - among others described in [10] and whose critical discussion has been expanded in [11] - is the lack of consideration for the dynamics of the eco-systems. Territories are, actually, multidimensional spaces of fluxes and are such fluxes that define the cultural identity of a place and, as well, the range of relevant interactions. Despite the significance of the dynamics, clearly demonstrated by many recent works [12-14], all attempts to benchmark cities’ smartness have produced and continue to produce only static rankings that provide, moreover, partial views of the state of the art [10]. All this appears even more paradoxical if you consider that the cultural dominance of a region during a given historical period (e.g. Florence during the Renaissance) has been sustained by a continuous dynamical tension, or *flow* [15]. Transliterating from a person to a city we could

state that *a smart city is a city where the human capital, (and more in general each individual/citizen) owns not only a high level of skills (possibly innovative ones) but is also strongly motivated by continuous and adequate challenges*. The state of *flow* of a city, thus, should be maintained by cooperative and convergent actions carried on by all main stakeholders. A meaningful smart city benchmarking cannot avoid to measure the *city's state of flow* that is also unavoidably related with the well-being and the individuals' state of flow and their expectations.

To this respect it is interesting to highlight another contradiction common to many models. For many of them the citizen-person is considered apparently a central element of the system, an element that has to be "self-decisive, independent and aware" [4] and that, as well, enjoy "a high quality of life" as actor of "participatory governance" [16] to produce social innovation and mitigate or solve problems that may derive from the growth of the system. In practice, however, factors and indicators considered to benchmark the cities' smartness are actually mirroring the infrastructural development, the optimization of the consumption of primary tangible and intangible resources (energy, water, materials, food, etc.), the thinning of the related flows of people, goods and data and the products of the processes under way in the territory. "Smart citizens", thus, remain in the shadow and are considered, rather, as "smart entities" that must be educated to adopt rational behaviours compatible with the policies put in place by the municipalities, usually aimed at promoting a "sustainable economical development". The person, her/his experiential styles and her/his quality of life seal incidental with respect to the "well-being" of the complex organism, i.e. the smart city, as a whole.

At this point, however, it should be quite clear to the reader that there cannot exist smart cities without smart citizens and that cannot exist smart citizens without smart cities. People and environment are peer components of a co-evolutionary ecosystems, so that people (citizens) should unavoidably be considered at the same time the main source and the end-target of the positive tension characterizing a territory. As a consequence we cannot expect to get a reliable benchmarking of the smartness without considering and analysing the data produced by the crowd and/or communities of any size (from small to big), data that, then, should be filtered and transformed in "smart data" to catch both quantitative and qualitative aspects characterizing either the outcomes of processes and the processes by themselves. Because of this, in [10] we have extensively discussed how traces left by people could be used to benchmark a territory and here, as an example, we will report on the "wisdom of the crowd" extraction operated by means of text analysis applied to the answers given to a questionnaire on Smart City.

## **2 "Wisdom of the Crowd": the case study of the Smart City Learning Questionnaire**

In February 2014 a questionnaire on Smart City Learning has been answered by 434 high school and K12 teachers, living mainly in the Rome area. Not all participants

answered all questions. The objective was to extract the perception that individuals owning a high cultural level have of *smart cities* and, as well, their feeling about the transformation that a growing city smartness may induce on “future learning”.

The participants have been asked to answer 9 open questions. Here, due to the lack of space, we concentrate on the analysis of the answers given to the first three questions, focused on *smart cities* perception and on the expectations about the transformations that territory/city and people may undergo when become smarter:

Q1) *What does smart city mean ?* (428 answers)

Q2) *How could your city get "smarter"?* (422 answers)

Q3) *Which skills/abilities should be acquired by a citizen to get "smarter"?* (396 answers)

The answers were analysed to rank the word occurrence. After the elimination of the meaningless words contained in the questions, the others were grouped by themes, and clustered according to three levels of occurrence: words contained in more than 5% of the answers, between 2% and 5% and between 1% and 2%. The clusters of words are reported in Tables 1-3 A (dedicated to names) and B (dedicated to verbs). Note that next to each word it has been reported the number of its occurrences.

**Table 1A:** Q1: “*What does smart city mean ?*” Derived Mental Model: Nouns -> Relevant themes

|                                   | > 5%                                                     | 5% ÷ 2%                                         | < 2% ÷ 1%                                                                                                                                                                         |
|-----------------------------------|----------------------------------------------------------|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Citizenship</b>                | cittadini 189                                            | abitanti 16                                     | cittadinanza 4                                                                                                                                                                    |
| <b>Life, person and community</b> | vita 163<br>misura d'uomo 34<br>persone 31               | comunità 11                                     | relazioni 7<br>senso 7<br>interazione 4                                                                                                                                           |
| <b>Expectations</b>               | qualità 128;servizi/o 95<br>esigenze 47<br>efficienza 27 | miglioramento 11<br>sviluppo 19<br>bisogni/o 14 | capacità 8; necessità 7<br>accesso 6; fruizione 6<br>strumenti 6<br>attenzione 6<br>benessere 5<br>problematiche 5<br>problemi 5<br>innovazione 4<br>riduzione 4<br>opportunità 4 |
| <b>Environment</b>                | ambiente 106<br>risorse 24                               |                                                 | sostenibilità 7<br>ecosostenibilità 5<br>sprechi 5<br>consumi 4<br>verde 4<br>vivibilità 4                                                                                        |
| <b>Technologies</b>               | tecnologia/e 97                                          | ICT 21<br>infrastrutture 14                     | rete 7; internet 6                                                                                                                                                                |
| <b>Communication</b>              | comunicazione 42<br>informazione/i 23                    |                                                 |                                                                                                                                                                                   |
| <b>Mobility</b>                   | mobilità 22                                              | trasporti/o 17                                  |                                                                                                                                                                                   |
| <b>Time</b>                       | tempo/i 21                                               |                                                 |                                                                                                                                                                                   |
| <b>Municipality related</b>       | istituzioni 21                                           | gestione 9                                      | amministrazione 5<br>governance 4<br>pianificazione 4                                                                                                                             |

|                              |  |                            |                                      |
|------------------------------|--|----------------------------|--------------------------------------|
|                              |  |                            | politica 4                           |
| <b>Spaces &amp; Places</b>   |  | spazio/i 18<br>luogo/hi 15 | territorio 6<br>urbanistica 4        |
| <b>Productive activities</b> |  | imprese 16; attività 10    | progetti 6; processi 5<br>economia 4 |
| <b>Culture</b>               |  |                            | cultura 6                            |

**Table 1B:** Q1: “What does smart city mean ?” Derived Mental Model: Verbs -> Relevant associated actions/effects

|                              | > 5%                            | 5% ÷ 2%                   | < 2% ÷ 1%                                                         |
|------------------------------|---------------------------------|---------------------------|-------------------------------------------------------------------|
| <b>Improve &amp; Enable</b>  | migliorare 108<br>soddisfare 31 | offrire 17                | aiutare 5; facilitare 5<br>permettere 5<br>conciliare 14          |
| <b>Make &amp; Use</b>        | agire 33                        | rendere 11; utilizzare 10 | sfruttare 6                                                       |
| <b>Succeed &amp; Empower</b> |                                 | riuscire 18               | potere 6; risolvere 5<br>raggiungere 4<br>realizzare 4; ridurre 4 |
| <b>Living</b>                |                                 | vivere 13; abitare 12     |                                                                   |

From Table 1A emerges a description of smart cities very little related to infrastructures and politics/government. Participants feel themselves as citizens, i.e. as part of an urban context, but this latter is perceived as smart only when is able to improve the quality of everyday life of people and communities, to support the development of environments at a human and sustainable scale and to preserve them. Technologies, though accepted as backbone needed to enable the smartness of the territory, remain and must remain in the background to support communication and fluidity of information and transportation. Government related aspects do not appear in the foreground, perhaps to emphasize the gap that nowadays separates citizens and institutions; nevertheless to these latters are ascribed administrative and planning functions relevant to the city management. The economy and productive activities, that are central in the traditional models of Smart Cities, are perceived only as enablers, not as the ultimate goals of the life. From the point of view of goals and objectives (Table 1B), a city can be considered smart only if capable to produce improvements, satisfaction, and to support citizens in their everyday life.

**Table 2A:** Q2: “How could your place become more ‘intelligent’?” Derived Mental Model: Nouns -> Relevant themes

|                     | > 5%                                 | 5% ÷ 2%                           | < 2% ÷ 1%                                                                              |
|---------------------|--------------------------------------|-----------------------------------|----------------------------------------------------------------------------------------|
| <b>Services</b>     | servizi 123                          |                                   |                                                                                        |
| <b>Citizenship</b>  | cittadini/o 85; vita 29              | senso 13; abitanti 12             | cittadinanza 5; vivibilità 5                                                           |
| <b>Technologies</b> | tecnologie/a 49; rete 35;<br>wifi 30 | internet 17;<br>infrastrutture 12 | ICT 6; informatizzazione 6;<br>banda larga 5;<br>smartphone 5;<br>piattaforma 5; web 4 |
| <b>Mobility</b>     | trasporti/o 49;                      | strade 13; mobilità 12;           | strade 13; mobilità 12;                                                                |

|                                    |                                             |                                                                |                                                                                                                                                                                                     |
|------------------------------------|---------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                    | parcheggi 22;<br>traffico 21                | viabilità 11                                                   | viabilità 11                                                                                                                                                                                        |
| <b>Expectations</b>                | risorse 32; qualità 25                      | utilizzo 18; accesso 17<br>miglioramento 12<br>possibilità 10  | incremento 4;<br>cambiamento 4;<br>costruzione 4; creazione 4                                                                                                                                       |
| <b>Time</b>                        | tempo/i 29                                  |                                                                | orari 6                                                                                                                                                                                             |
| <b>Communication</b>               | informazioni/e 29<br>comunicazione 23       |                                                                |                                                                                                                                                                                                     |
| <b>Spaces &amp; Places</b>         | spazi 28; centro/i 27<br>luoghi 22; zone 20 | aree verdi 17<br>territorio 16<br>illuminazione 10<br>casa/e 9 | marciapiedi 6; edifici 5<br>barriere architettoniche 4                                                                                                                                              |
| <b>Environment &amp; Resources</b> | raccolta rifiuti 24<br>energia/e 20         | ambiente 17<br>inquinamento 15<br>piste ciclabili 12           | sprechi 8; bus elettrici 7<br>fonti rinnovabili 7; parchi 6<br>sostenibilità 6; consumi 5<br>riciclo 5; acqua 5<br>risparmio 4; cassonetti 4                                                        |
| <b>Systems &amp; Processes</b>     | gestione 24;<br>sistema/i 21                | efficienza 15<br>processo/i 10<br>progetto/i 9; strutture 9    | ottimizzazione 7<br>potenziamento 7; sviluppo 6<br>organizzazione 6<br>pianificazione 6; piano 6<br>strumenti 5<br>implementazione 5<br>razionalizzazione 4<br>soluzioni 4                          |
| <b>Culture &amp; Education</b>     |                                             | scuola/e 19<br>cultura 16                                      | biblioteche 6<br>eventi 5<br>cinema 4                                                                                                                                                               |
| <b>People &amp; Communities</b>    |                                             | persone 17<br>aggregazione 9                                   | comunità 8; anziani 6<br>giovani 6; collaborazione 5<br>condivisione 5<br>popolazione 5<br>disponibilità 5<br>partecipazione 4<br>collettività 4<br>ragazzi 4; bambini 4<br>interazione 4; utenti 4 |
| <b>Needs (words for)</b>           |                                             | bisogno/i 14<br>esigenze 11<br>problema/i 10                   | attenzione 7; richieste 4                                                                                                                                                                           |
| <b>Productive activities</b>       |                                             | attività 13; impiego 11                                        | imprese 6; lavoro 4<br>produzione 4                                                                                                                                                                 |
| <b>Municipality related</b>        |                                             | amministrazione 12<br>uffici 10                                | istituzioni 8; pratiche 6<br>politica 6; regole 4<br>municipio 4                                                                                                                                    |
| <b>Security</b>                    |                                             |                                                                | sicurezza 7; controllo 6<br>monitoraggio 6                                                                                                                                                          |

Table 2B: Q2: "How could your place become more 'intelligent'?" Verbs .-&gt; Expected effects

|                             | > 5%          | 5% ÷ 2%     | < 2% ÷ 1%                                                        |
|-----------------------------|---------------|-------------|------------------------------------------------------------------|
| <b>Improve &amp; Enable</b> | migliorare 59 | favorire 13 | offrire 8; ottimizzare 8<br>ridurre 8; soddisfare 5<br>fornire 4 |

|                             |              |                          |                         |
|-----------------------------|--------------|--------------------------|-------------------------|
| <b>Augment &amp; Create</b> | aumentare 30 | creare 19;potenziare 11  | incrementare 4          |
| <b>Make &amp; Use</b>       |              | rendere 18;utilizzare 13 | iniziare 6; sfruttare 5 |
| <b>Invest &amp; Manage</b>  |              | investire 13             | gestire 8               |

When people have been asked to explain how the city could become smarter, clear expectations towards technologies as enabling agents have emerged. Technologies should be capable to foster a more "sustainable citizenship" especially through the creation and supply of services that are expected to foster improvements and enabling conditions, especially for what concern: a) mobility and time optimization (including the individual one); b) circulation of information; c) care for the environment (either as far as physical spaces are concerned and in terms of a more conscious use of resources); d) support to culture and education, to people and communities; and - in the lower part of the ranking – e) productive activities perceived as suppliers of jobs and relationships with the administration; also an attention towards security issues started to emerge.

It is interesting to note that all the above issues are actually perceived as components of a holistic and systemic vision of a territory that needs, anyway, optimized organization, planning and management.

From the point of view of the actions, see Table 2B, technologies are expected, in a very general manner, to generate improvements and, in particular, to support the development of enabling conditions to foster creativity and stimulate the attraction of investments.

**Table 3A:** Q3: "Which skills/abilities can make a citizen 'smarter'?" - Nouns

|                     | > 5%                             | 5% ÷ 2%                                                                                                      | < 2% ÷ 1%                                                                                                                                                                                                                        |
|---------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Technologies</b> | tecnologia/e 90                  | internet 17; rete 15                                                                                         | computer 7; tecniche 6<br>sistemi 6; dispositivi 5<br>tablet 4                                                                                                                                                                   |
| <b>Knowledge</b>    | conoscenza 67<br>informazioni 40 | comunicazione 14                                                                                             |                                                                                                                                                                                                                                  |
| <b>Environment</b>  | ambiente 29<br>territorio 27     |                                                                                                              |                                                                                                                                                                                                                                  |
| <b>Education</b>    | senso 24<br>cultura 22           |                                                                                                              | educazione 6; scuola 6<br>contenuti culturali 4<br>formazione 4<br>aggiornamento 4<br>metodologie 4<br>lingue 4; percorsi 4                                                                                                      |
| <b>Expectations</b> |                                  | apertura mentale 19<br>cambiamento 13<br>voglia 12<br>creatività 11<br>innovazione/i 11<br>consapevolezza 11 | curiosità 8<br>miglioramento 8<br>disponibilità 6; qualità 6<br>potenzialità 5<br>esperienza 5<br>intelligenza 5<br>flessibilità 5<br>coscienza 5; crescita 5<br>sensibilità 5; futuro 5<br>gioco 5; sviluppo 4<br>possibilità 4 |

|                                   |  |                                         |                                                                                                                                                  |
|-----------------------------------|--|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
|                                   |  |                                         | familiarità 4<br>adattamento 4<br>pensiero 4                                                                                                     |
| <b>Tools &amp; Resources</b>      |  | strumenti 14; risorse 10<br>soluzioni 9 | accesso 8; mezzi 8                                                                                                                               |
| <b>People &amp; Communication</b> |  | cittadini 12                            | persone 8<br>interazione 7<br>comunità 6<br>partecipazione 5<br>persona 5                                                                        |
| <b>Miscellaneous</b>              |  | vita 18; problemi 13                    | tempo 7; volontà 8<br>predisposizione 7<br>propensione 7<br>problematiche 5<br>processo 5; progetti 4<br>protagonista 4<br>bisogni 4; esigenze 4 |

**Table 3B: Q3: “Which skills/abilities can make a citizen ‘smarter’?” - Verbs .-> TO (actions):**

|                             | <b>&gt; 5%</b> | <b>5% ÷ 2%</b>             | <b>&lt; 2% ÷ 1%</b>                                                                               |
|-----------------------------|----------------|----------------------------|---------------------------------------------------------------------------------------------------|
| <b>Use &amp; Access</b>     | utilizzare 37  | usare 12                   | accedere 5; acquisire 4                                                                           |
| <b>Know &amp; Elaborate</b> | sapere 36      | conoscere 16;<br>sapere 14 | capire 6; imparare 6<br>pensare 6;<br>comprendere 5                                               |
| <b>Communicate</b>          |                | comunicare 9               |                                                                                                   |
| <b>Act to</b>               |                |                            | migliorare 8;<br>contribuire 6; rendere 6<br>creare 4; agire 7<br>sperimentare 4                  |
| <b>Interact</b>             |                |                            | interagire 6<br>confrontarsi 4<br>condividere 4<br>partecipare 4<br>relazionarsi 4<br>adattarsi 4 |
| <b>Respect</b>              |                |                            | rispettare 6                                                                                      |
| <b>Live</b>                 |                |                            | vivere 5                                                                                          |
| <b>Manage</b>               |                |                            | gestire 5                                                                                         |

Much less clear seems to be the picture that emerges from Q3. Despite of the high cultural level and the role of the participants, they were not yet able to formulate precise hypothesis about skills/capabilities that could make citizens smarter.

We can only state that, in their expectations, such new skills/capabilities should be technology related, should allow to get an easier access to knowledge, education and culture, should be able to foster the development of qualities that are at the foundation of a civil coexistence and, finally, an overall *positive tension*; probably the *flow* we made reference to in paragraph 1.

### 3 Conclusions

In conclusion the analysis presented in the previous paragraph has clearly demonstrated the need and usefulness to transform traces into smart data to extract perception and expectations about present and future smartness of a given territory. Moreover it has also shown that classical models of territorial and urban development and, as well, the dimensions that have been derived from them to benchmark cities' smartness, are very far from common perception and feeling, function of the benchmarking of the context operated at individual level. This latter concentrate, usually, on the well-being of the person (also when is playing the role of citizen) and on that of the environment where s/he is living and carrying on her/his activities. While in traditional models the *smart economy* comes out to be the driving force of at least 5 out of the 6 pillars used to benchmark smart cities [10], from the present analysis it emerges that only the mobility is perceived as particularly relevant (also because is related to the optimization of the personal time). Beside the personal sphere, it is the environment, and the economic activities related to its preservation, together with a careful consumption of resources, to be perceived as the leading key-factors of a potential growth of the territorial smartness. A result not unexpected if we consider that in [10] the *smart environment* has been found to be orthogonal to all other dimensions (5 pillars) considered relevant by traditional models.

Of course we do not intend to state that such traditional models of territorial and urban development should be completely disregarded, but nevertheless they should be probably deeply revised to integrate in a holistic and systemic vision *top-down* and *bottom-up* approaches, to weight in a reasonable manner also dimensions that are closer to the perception and styles of individuals, considered either as persons that as citizens and, finally, as member of multiple communities.

Another possible concern, emerging from our analysis, is the existence of a gap between citizens/persons, the productive activities and the administration. Since it turns out to be partially due to poor communication strategies, it seems advisable for policy makers to develop new and more effective ones to "communicate" data produced by the territory and their dynamical evolution: it is not enough to open the data but they should be communicated in a smarted and engaging ways incorporating, for example, storytelling [17] and gamification [18] strategies.

The analysis contained in the previous paragraph also show how transformations that may arise because of territorial development and technology penetration are expected to be harbinger of a *positive tension*, perceived not only as an enabling factor but also as a driving one for creativity and innovation. It follows unavoidably the need to constantly monitor the *state of flow* of a territory.

Resuming cities/territories will be truly smart and, accordingly, the benchmarking of the smartness reliable enough, only if people:

- *IA.* - Adopt a systemic and holistic co-evolutive thinking (focused also on person/citizen and environmental relevant dimensions);
- *IB.* - Promote a merging of bottom-up and top-down approaches;

- 2. Is able to keep the city/territorial in a state of flow and measure it;
- 3A. Monitor traces produced by the crowd and analyse them to transform big in smart data;
- 3B. Communicate, to foster awareness and involvement, possibly by adopting engaging strategies.

*All this also means that the smartness of a territory/city should be a function of the state of flow and expectations of its inhabitants.*

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