A New Dimension of Business Intelligence: Location-based Intelligence

Zeljko Panian

Abstract—Through the course of this paper we define Location-based Intelligence (LBI) which is outgrowing from process of amalgamation of geolocation and Business Intelligence. Amalgamating geolocation with traditional Business Intelligence (BI) results in a new dimension of BI named Location-based Intelligence. LBI is defined as leveraging unified location information for business intelligence. Collectively, enterprises can transform location data into business intelligence applications that will benefit all aspects of the enterprise. Expectations from this new dimension of business intelligence are great and its future is obviously bright.

Keywords—Business intelligence, geolocation, location-based intelligence, innovation, location-intelligent business

I. INTRODUCTION

MOST businesses are immersed in a world of readily accessible data that could significantly improve their companies' efficiency, effectiveness, and profitability. Unfortunately, only a minority of firms currently takes advantage of this rich mine of data – or, apparently, are even aware that it exists. And yet that data not only surrounds most modern organizations, but invites their leaders to dig as deeply as they might wish. That data, in short, is an undiscovered gold mine, and it can be collected, analyzed, and deployed much more easily than one might expect [1]. This undiscovered gold mine of data includes the demographics, economics, physical geography, and other characteristics that pertain to location – the spatial environment in which a given organizations operates, interacts with its customers, and transacts business. Like the proverbial tree falling deep in an empty forest, this data exists independent of anybody's taking note of it.The data becomes valuable to an organization, however, only when it is collected and analyzed, and when the conclusions resulting from its analysis are used to inform the organization's decision-making [2]. For instance, absolute data like a city's population can serve as a rough gauge of a market's potential, but only relative data – a matching of store locations to local demographics, or the comparison of a company's own wireless network to those of its competitors – can yield true Location-based Intelligence (LBI).According to results of a recently conducted survey [3], more than 80% of all data maintained by organizations around the world has a location component. Just like the CRM-style analytical solutions of a decade ago, location intelligence offers value to an organization by using sophisticated technology and analysis to help executives and enterprise-level users alike make critical business decisions.

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Using economics, demographics, physical geography and other data pertaining to location, location intelligence helps detect patterns, risks, and opportunities often difficult to see in a basic spreadsheet analysis. For financial, insurance, communications, and retail operations, location intelligence provides very specific benefits, which translate to increased revenues, reduced costs, and improved efficiency for any organization.Yet many high-level executives, unfortunately, still have not embraced this technology.

II. GEOLOCATION

Companies are investing heavily to reach as many Web users as possible, building country-specific Web sites and translated content – a process known as Web globalization. All industries are rapidly expanding their geographic reach on the Web.

Unfortunately, as this universe of multilingual content expands, so to do the odds of Web users getting lost within it [4]. Companies cannot simply control how people arrive at their Web sites, so they need to do all they can to ensure that, once Web site visitors have arrived, they easily find where they need to go. A resolution to this problem can be found in so-called *geolocation*.This is the process of automatically identifying a Web user's physical location without that user having to provide any information, such as a ZIP code. Geolocation works on all Web browsers, requires no plug-ins or cookies, and is already used by many of the world's most successful Web sites.The foundation for geolocation is the Internet protocol (IP) address. When users surf the Web, their computers send out these IP addresses to every Web site they visit. IP addresses are not like mailing addresses. That is, most are not fixed to a specific geographic location. And knowing that a particular Internet Service Provider (ISP) is based in a particular city is no guarantee that its customers are also located somewhere nearby. That's where geolocation service providers fit in.

Geolocation service providers build massive databases that link each IP address to a specific location. Because the IP system is in a constant state of flux, many providers update their databases on a daily or weekly basis. Some geolocation vendors report a 5-10% change in IP addresses locations each week [5].

Geolocation can provide much more than a geographic location. Many geolocation providers supply up to 30 data fields for each IP address that can help to further determine if users really are where they say they are.

- country, region, state, city, ZIP code, area code
- latitude/longitude
- time zone
- designated market area (DMA)
- network connection type and speed (i.e. dial-up or broadband; slow or fast)
- domain name and type (i.e. .com or .edu), etc.

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Equipped with this information, companies may respond to the Web user with a wide range of localized content. For example, if they have an e-commerce site, they could present prices in dollars or yens instead of Euros. They may also presents products that are most relevant to the user's location (urban vs. rural) and season (summer vs. winter). Knowing whether or not a Web user is connecting via broadband allows businesses to decide between serving bandwidth-intensive video or static visuals. And they may prohibit someone from seeing or buying a product that is illegal to distribute in his or her country.

Companies may also infer the person's language from an IP address, which is not without risk. To increase the odds of success, they should also configure their Web server to detect the language preference of that Web user's browser. Therefore, if it is known the person is based in France and his or her browser is set to request French content, the odds are good that the person speaks French.

Geolocation is integrated into a company's Web site through simple Application Programming Interfaces (APIs) or Web scripts that allow the company's Web server to query the geolocation database before responding to the Web user with content. Once the Web server knows where the user is located, simple "if then" business rules may then be followed [6]. For example "if" the Web user is in France, "then" serve him the French Web site, or take him to the main .com site, but serve content that has been translated into French.

Companies may also have business rules to protect from "card-not-present" transaction fraud; if the Web user is based in a country with high rates of fraud, IP addresses from that country may be blocked from accessing the online store. IP address location may be also compared to the billing address location to look for mismatches.

Amalgamating geolocation with traditional Business Intelligence (BI) results in a new dimension of BI named *Location-based Intelligence (LBI)*. It can be effectively used as a strong and helpful strategic management tool.

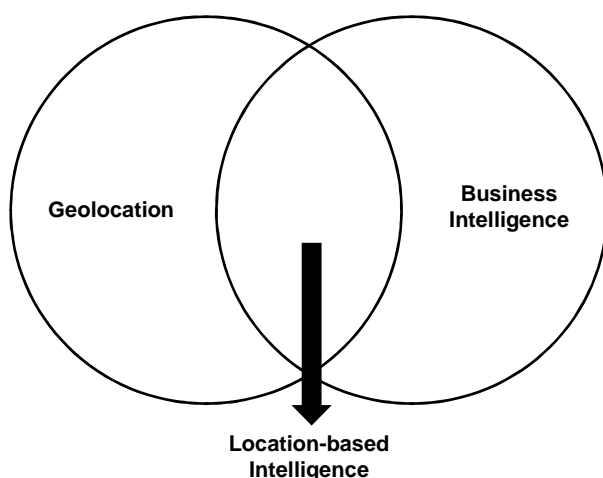The process of amalgamation of geolocation and Business Intelligence is schematically shown in Fig. 1.

Fig. 1 Amalgamation of Geolocation and Business Intelligence

III. THE POWER OF LOCATION-BASED INTELLIGENCE

Almost all organizations give at least passing attention to the characteristics of location, whether in evaluating traffic patterns in choosing a factory location, determining optimal travel routes, or calculating market wages in deciding where to site an industrial plant [7]. There is certainly benefit even in these isolated, often unstructured observations. But assessing the impact of location in this way – call it "location inference" – is a little like stargazing without a telescope.

While certain patterns and points of light may be visible to the naked, stargazing eye, the intricate relationships among stars, the evolution of star systems over time, and even hidden celestial features like distant planets and neutron stars become apparent only when one systematically searches the sky with advanced, finely tuned optics. Although less familiar than giant telescopes, the software and analytical tools necessary for systematically probing location-based data closer to home are just as well developed, and offer willing companies a far richer and more informed perspective on their physical operating environment than is possible with more casual analyses.

These tools allow companies not only to observe and collect data describing even the hidden, business-relevant features of their location, but also to probe and deploy this data in a way that greatly enhances understanding of the impact of location and, ultimately, enables organizations to dramatically reduce costs, increase revenues, and boost profits. Such tools thus help to translate the notational "location inference" into a much more powerful form of location-based knowledge called Location-based Intelligence (LBI).

Conceptually, LBI bears many similarities to the *customer intelligence* concept that grew to prominence during the 1990s and that underlies such well-known technology solutions as *customer relationship management* software, more commonly known as CRM.

The core premise of customer intelligence and CRM software in particular was that, if a company knew more about a particular customer's demographics, preferences, and buying habits over time, it could tailor marketing offers and customer interactions in a way that would increase the customer's propensity to buy and, in general, boost the customer's overall lifetime value [8]. So accepted has the concept of customer intelligence become in the years since then that virtually every business now employs it – some intuitively, others within the context of a formal CRM solution.

As noted, LBI has also been part of business operations for decades, at least in a rudimentary form. For instance, long before the advent of computers, delivery firms planned pick-ups and drop-offs so as to minimize travel time and fuel use. Retailers and service franchise owners like supermarkets and car repair shops typically have taken a number of factors into account before deciding where to locate their businesses. And, of course, real estate agents have long known that home values are determined primarily by three factors: location, location, and location.

As obvious as these examples are, they represent only a fraction of the actionable intelligence inherent in a company's location, and a small portion of the value that can be obtained today from sophisticated LBI tools. Location and its business-

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relevant implications, in fact, infuse nearly all business operations: every organization with a physical presence exists somewhere, and the same is true of nearly all of that organization's customers and suppliers.

IV. LOCATION-INTELLIGENT BUSINESS

To stay in business, companies must compete with other companies not only at one-to-one basis but also through the capability of their supply chains. It is no longer company versus company, but rather one supply chain versus another. Companies can improve visibility into their supply chain with actionable real-time location information, which is becoming increasingly feasible as emerging wall technology becomes cost-effective. In other words, companies are forced to recognize, build, improve and maintain their Location-based Intelligence.

Location-based Intelligence is defined as leveraging unified location information for business intelligence. Every person, place or thing in an organization is associated with a location. In many cases, ERP, CRM, HRM or another decision support system has already captured that information on an ad hoc or real-time basis.

Fig. 2 depicts a Location-intelligent Enterprise. Notice the number of activities a company performs that have a location component supported by world and walls technology as well as the interrelationships between activities.

Better risk management implies:
- location-aware security
- more accurate contingency planning
- product and market trends discovery

Customer service is improved concerning to:
- sales information inquiry
- help desk services
- transaction status tracking

Improvements in distribution and logistics:
- more accurate logistics planning
- more efficient soft goods delivery
- better inventory management

Growth in customer acquisition comes out of:
- more precise site selection
- defining sales territory
- sales collateral distribution
- online and mobile promotion and targeting

Operations are enhanced through:
- faster order processing
- higher degree of asset utilization
- better resource allocation

Supply chain collaboration is strengthened by:
- availability to promise
- advanced planning engines
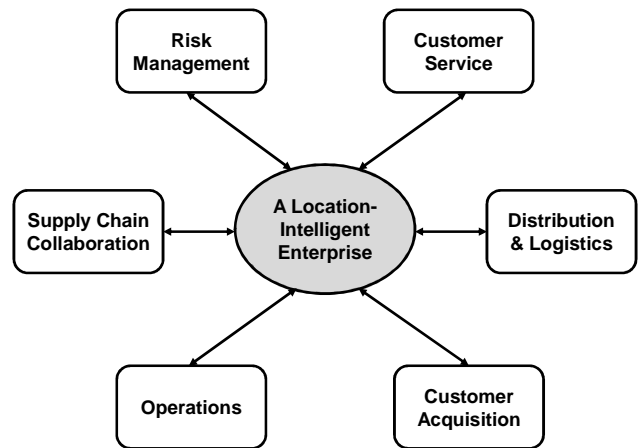- better product information management.

Fig. 2 Location-intelligent Enterprise

However, enterprises have underutilized location information in their decision-making for many reasons:
- cost of purchasing and maintaining a geographic information system (GIS)
- difficulties in obtaining real-time location information
- cost to purchase, store and process location imagery
- poorly maintained location information in information systems
- complexity of using location information in existing business processes
- historically high immaturity of wall technology.

Enterprises are awakening to the amount of location information collecting in their decision support systems [9]. Leaders are beginning to ask how to better leverage the "where" in operational and strategic decisions. And yet, enterprise managers take a diverse rather than unified approach to managing location information and technology investments. Systems remain disconnected. Location information quality is handled in an ad hoc manner on an application-by-application basis - not enterprise-wide. As a result, information gaps exist throughout the various functional areas of the enterprise.

V. FROM ENTERPRISE LOCATION DATA TO LOCATION INTELLIGENCE

Collectively, enterprises can leverage location data into business intelligence applications that will benefit all aspects of the enterprise. Location intelligence falls into the following enterprise categories [10]:
- *Business decisions:* These are enterprise applications that provide insight into optimal business strategy operations and intelligence. Typically, the solutions are industry-specific, ranging from trade area selections in retail to asset utilization in healthcare.
- *Customer-facing activities:* These are enterprise applications that provide CRM features such as customer service and self-service. Real estate is an area that has embraced location intelligence and has begun to explore the possibilities for sales, marketing, customer service and self-service.

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- *Consumer applications:* Mash-ups are perfect examples of businesses focused on providing services to consumers. Ad sales drive the majority of these companies' revenue. In addition, companies are beginning to apply location-based services to various mobile gaming consumer applications.

With recent technology advances, it is possible to affordably map an area or locate objects regardless of their location. Specifically, satellite-based location systems have delivered enormous benefits to enterprises for at least two decades. However, these systems do not work indoors. Today's availability of location technology for indoor environments is creating a new collection of data that can directly affect how work is done inside an enterprise by knowing where objects came from or where they are.

Location intelligence innovation may be viewed as clustered around two main areas:

- The world: *A macro-environment* where location is determined in a global, latitude/longitude dimension. Examples include applications ranging from geospatial analysis to geographical points of interest.
- The walls: *A micro-environment* where location is determined relative to a limited area such as a building, warehouse, shop floor or campus. Examples include applications ranging from workflow optimization to asset tracking and utilization.

As consumers become more location-aware through the use of consumer applications, they bring that awareness to the office, where location traditionally is thought of as an attribute of operations. With Google maps and Web 2.0 technologies, like mash-ups or RSS, providing fast, convenient and useful information, consumers' expectations about how tools should or could work at the office are changing. In addition, enterprises are exploring how they can optimize location in their applications. Traditional business intelligence vendors are beginning to collaborate with geospatial vendors to strengthen their business intelligence offerings.

Increasingly, consumers want to connect to the Internet anywhere and at anytime. To offer these services, businesses manage access through location-sensing technology to prevent security breaches. In addition, the ability to document the "where" for compliance with laws and control of policies and procedures has benefited the healthcare and airline industries.

While compliance and security risks have increased, the cost of location technology for business decisions has decreased. The lower cost, stability and flexibility of campus middleware platforms will enable businesses to more freely invest in and explore wireless local area networks (WLANs), wireless personal area networks (WPANs) and end devices such as sensors and handsets in their operations.

VI. SOME EXAMPLES OF LOCATION-BASED INTELLIGENCE RELEVANCY

A. Retail

In retail, where a store is located tends to affect sales performance more than any other factor. Great managers, great marketing and advertising programs, and even great products often have far less effect on sales than does a premium location. As a result, sophisticated location intelligence tools can help retail owners to:

- determine optimal store locations
- simultaneously maximize market share and per-store performance
- quantify and avoid cannibalization among stores
- generate detailed site-specific forecasts for operations and strategic planning
- precisely match media and marketing messages to targeted households
- determine how well a concept translates from one market to another
- identify underperforming stores and determine which to close and which to renovate.

B. Financial Services

In financial services, diversification and commoditization have forced down margins to the point that financial services firms, in order to remain profitable, must optimize every transaction and every customer touch point. Location-based intelligence benefits these financial services providers by helping them to [11]:

- maximize individual branch performance
- evaluate expansion opportunities by determining the optimal number, placement, and priority of new branches
- optimally allocate branch and sales staff
- isolate or separate personnel performance problems from intrinsic market problems
- better understand customer needs, preferences, and behaviors
- matching financial product mix to both customer segment demographics (e.g., increased mortgage demand in growing suburbs, retirement planning, etc.) and life events (e.g., saving money for college)
- identify underperforming branches and determine whether to retain, relocate, or close them.

C. Insurance

In insurance, underwriters that do not take full account of the locations covered by their policies do not fully understand the risks that they are assuming – and often suffer financially as a result. Hence, location intelligence tools can assist insurers by:

- accurately assessing marketing potential, better focusing marketing, sales, and distribution management, and maximizing producer effectiveness
- improving underwriting decisions by providing more accurate exposure analyses
- increasing competitiveness through more refined and accurate pricing
- increasing organizational efficiency and profitability through deployment of "low touch" or "no touch" automated underwriting systems, augmented rules engine technology, and enhanced service-oriented architectures supported by web services applications
- managing risk on a portfolio basis and complying with

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regulatory reporting requirements
- streamlining claims handling processes and providing added-value customer service offerings.

D. Telecommunications

Wireless and mobile are major characteristics of today's telecommunications. Many wireless companies have learned a very expensive lesson that even minor variances in location can greatly affect service quality, customer retention, and profitability. In addition to avoiding or minimizing problems like these, communications companies can benefit from location intelligence tools by:

- analyzing market demand, network coverage, and competitor data in order to optimize network design, build-out, and maintenance
- providing superior customer service, including identification of emerging trouble spots, calculation of downtimes, and real-time deployment of network engineers
- understanding customer demand and competitive threats so as to enable creation of market-driven offerings and competitive pricing schemes
- generating highly qualified sales leads based on service availability and various customer groups' likelihood of subscribing.

As an example, assume a communications company needs to determine the market potential for its service offerings. Using a location-based intelligence solution, the company might define its trade area and then compare infrastructure and tax boundaries, overlaying them as base layers. To this information they might add demographics and customer segmentation data and conduct a spatial analysis in order to compare preferences in specific areas with service offerings available in those areas.

This unique analysis, when combined with the company's consolidated data and the right location-based functionality, would allow the firm to deploy services over an intranet or combine them into existing operational systems, thereby enabling the company to make profit-enhancing decisions in a more cost-effective and efficient way.

E. Public Sector

E-government principles, applications and implementations nowadays attract attention of many theoretical and empirical researchers. Government bodies and agencies are increasingly pressured to perform even while budgets for most functions are stretched more thinly than ever before [12]. LBI can strongly assist these organizations by enabling:

- attracting, retaining, and supporting local businesses in order to create jobs and strengthen the local tax base
- planning and development of large-scale public and infrastructure works projects
- evaluating the need for and effectiveness of federal aid resources in human services, economic development, agriculture, social care, and other fields
- enhancing disaster forecasting and emergency preparedness and recovery operations

- improving predictive capabilities and proactive actions for national security functions.

F. Internet-based Business

Even on the geography-less Internet, many companies practicing e-Business have discovered – contrary to original expectations – that some of their best customers live in less wealthy small towns, rural and mountain areas and isolated islands, where physical store offerings are more limited. Additional insights that location-based intelligence solutions can offer include:

- the optimal matching of product mixes across geographical locations and customer groups
- optimization and timing of free shipping and other incentive offers
- the effect of time-of-day and time-of-week on purchase/buying patterns in different geographies and across various demographics
- the optimal timing and pricing of Internet advertising, such as search engine keyword buys and banner advertisements.

G. Lessons Learned

No business would go to market without trying to gain a rich understanding of its customers and their behavior. The same is true with regard to evaluations of production, distribution, and other logistical matters, each of which can have significant effects on profitability.

Historically, the analysis of location-based data has been siloed within administrative departments or other non-revenue sectors of a company, or else have been given only notional, "gut instinct," location-inference consideration. But no longer; a growing contingent of organizations are learning that, not only does location matter, but that fully appreciating the impact and opportunities associated with location can generate significant, bottom-line returns.

VII. How to Profit from Location-based Intelligence?

Ultimately, location ties all of the other data sources in an organization's operations together. To use a very simplistic example, knowing a customer's age, family status, and buying history can inform, say, a sporting goods retailer's marketing efforts. But knowing further that the customer lives in Slovenia instead of, say, Hungary suggests that the customer might be a good candidate for buying ski gear or high-performance parkas – even if the customer in question has never purchased such items from the company in the past.

Similarly, basic mapping data can tell an insurance provider where its policies are located in relation to an intensive traffic zone or other high-risk areas. But only with a richer set of location-specific data could the provider automatically and accurately determine a policy applicant's exact distance from highways or urban centers, the overall risk exposure, and the optimal deductible – resulting in improved underwriting, customer service, and claims management practices.

These and many comparable examples confirm that Location-based Intelligence is just what it appears to be:

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invaluable organizational intelligence, drawn from both the organization's and customers' locations that can enhance the understanding of the organization's operating environment, and so be used to increase revenues, reduce costs, and improve profits. It is the same kind of value that CRM-style analytical solutions began bringing to customer-facing organizations a decade before.

And like those customer intelligence solutions, which depended heavily on advanced information technologies for their analytical and data-management power, so too are Location-based Intelligence solutions now being powered, not by gut instinct and consensus "guessing," but by advanced analytical and data-processing tools that can detect patterns, risks, and opportunities that otherwise would be invisible to human "eyeball" analysis.

VIII. CONCLUSION

Geolocation is a process of automatically identifying a Web user's physical location without that user having to provide any information, such as a ZIP code. Amalgamating geolocation and business intelligence may result in a brand new dimension of traditional business intelligence named Location-based Intelligence. Expectations from this new dimension of business intelligence are great and its future is obviously bright.

As consumers become more location-aware through the use of consumer applications, they bring that awareness to the office, where location traditionally is thought of as an attribute of operations. Collectively, enterprises can leverage location data into business intelligence applications that will benefit all aspects of the enterprise.

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