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Decoding the API Economy with Visual Analytics
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Application program interfaces (APIs) have grown significantly in recent years. These tools allow firms to interact and share informational assets with other firms through plug and play automated interfaces. Not only are there more APIs available today, they do much more, and companies are combining APIs to offer new ways for companies to create and capture value.

The growth of APIs is prompting some management scholars to make bold claims about the future of inter-firm relationships. For example, Bala Iyer and Mohan Subramaniam argue in a recent article in the *Harvard Business Review* that APIs are beginning to replace alliances as the most common means for partnerships. As they see it, digitization is creating new opportunities for firms to harness data, rather than physical, assets to create and capture value: "APIs are revolutionizing traditional business alliances and partnerships through scalability, flexibility, and fluidity."[1]

More broadly, others speak of an emerging API economy.[2] Better tools have simplified the integration of complex systems in ways that facilitate new levels of interaction and innovation, amplifying the network effects fueling many of today's platform companies like Salesforce. Standardization and specialization grow quickly through clearly defined protocols that are diverse and able to evolve. APIs can be restricted to a specific group of users (closed APIs) or can be made available for broad public use (open APIs). They can also generate either direct or indirect revenue to those that create them. The result is that many experts see APIs—both closed and open—playing a key role in facilitating and monetizing the emerging Internet of Things.

But exactly how are APIs evolving? Are all enterprises creating open APIs? Are all sectors equally engaged? If not, what types of information are most actively exchanged? Likewise, are all enterprises equally engaged in opening their APIs and allowing third-parties to build new applications? If not, which enterprises are most active and most central to the emerging API network? Is there potential for disruption among companies or industries slow to use APIs?

Visual analytics, the integration of interactive visualization with analytic models, provide a powerful way to explore these questions. In order to analyze the macro aspects of APIs and more detailed micro inter-firm relationships established through APIs, we gathered data on nearly 11,000+ APIs, 6,000+ mashups, across hundreds of categories ranging from search and eCommerce to transportation, health, and enterprise.[3]

We converted the API data into a network representation, where nodes represent APIs and links between the nodes represent if two APIs have been used jointly in a mashup. Links are scaled according to the total number of mashups: the thicker the line the more mashups were created using the two APIs.

There are many different network visualization algorithms available to render the data. The choice is often dependent on the question(s) being asked. As we are interested in the structure of the API ecosystem, we chose first to filter the network and exclude the less integrated APIs. This results in a core group of roughly 4,000 APIs. We then applied a force-directed algorithm that emphasizes seven major clusters within the data and provides an aesthetically attractive and intuitive aggregate layout. For each API in this network, we computed a betweenness centrality score, which indicates its prominence in the network, and scaled the size of each node accordingly. Lastly, we colored the network based on the clusters.
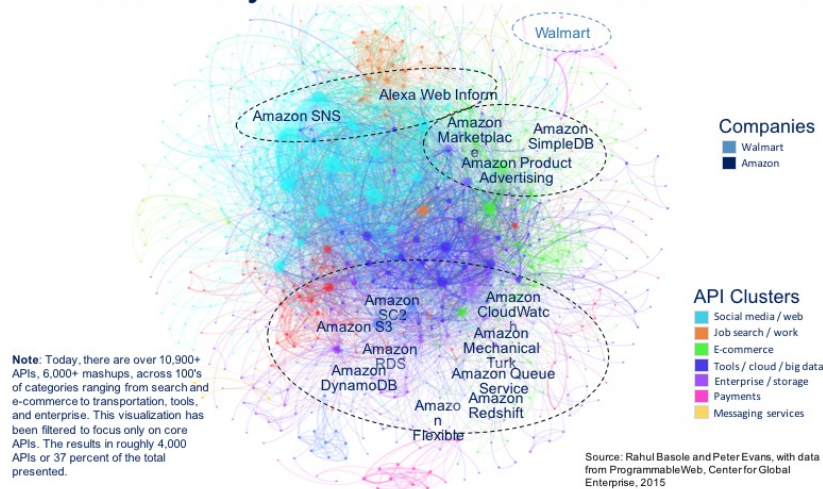
The result is a visualization of the current API economy presented here. While this rendering is static, the computer display of the visualization can be dynamic and interactive, allowing exploration of individual nodes and relationships between firms.

Source: Rahul Basole and Peter Evans, API Economy Visualized, Center for Global Enterprise, 2015
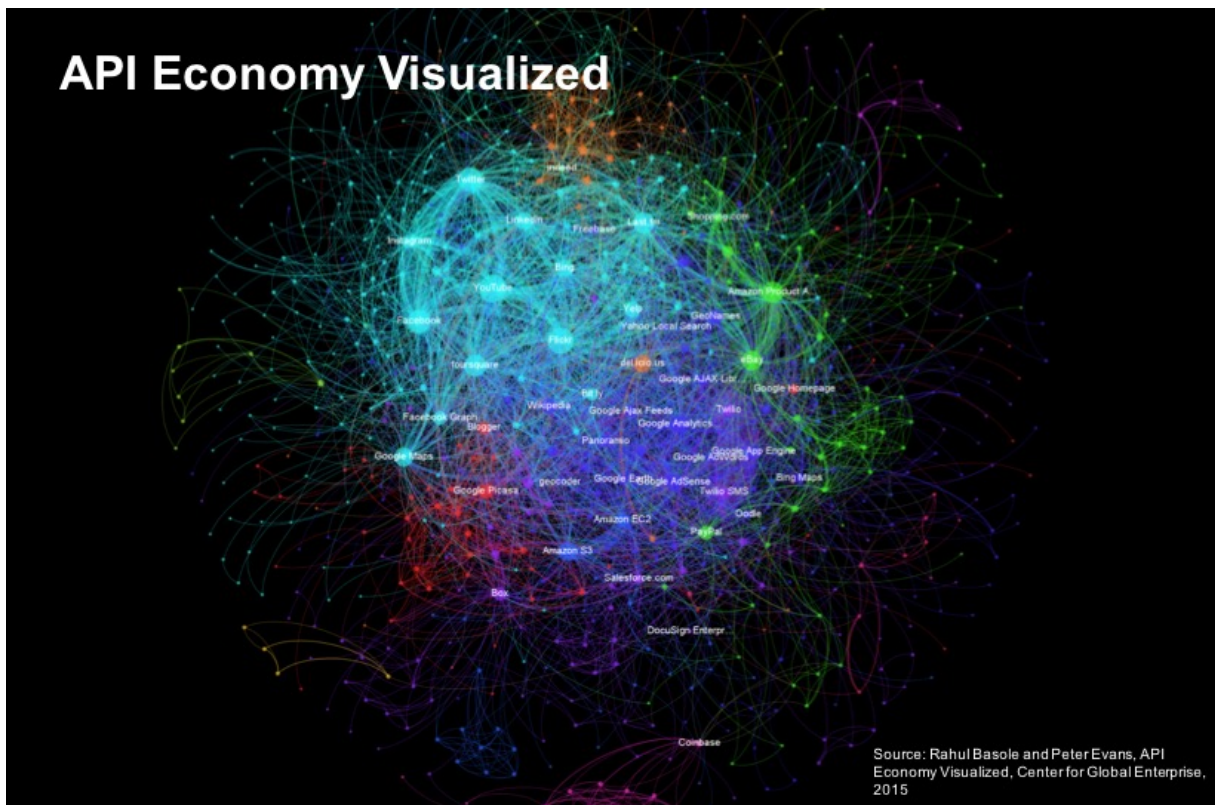
A quick review of the API mashup network reveals that few traditional firms are active in the open API economy. Few if any major companies appear in the core component, be they from banking, insurance, pharmaceuticals, food, transportation or energy. Instead, we see that the API economy is dominated by relatively young digital platform companies.   Most central to this emerging ecosystem are companies that have built businesses around areas such as social, mapping, search, on-line payment, image sharing, video and messaging.   They include well-known companies like Google, Microsoft, Facebook, Amazon, eBay, Yahoo, Salesforce and Twilio, as well as lesser-known companies like Quova, Anedot, and Zapier.

Visual analytics can reveal the consequences of these different paths.   Take retailers as one example.   An interesting result from the ecosystem visualization is the difference that emerges between Amazon and Walmart (see visualization below). Amazon has had an explicit policy of creating open APIs. The results show. Amazon has over 33 open APIs, which have been combined with other APIs to create over 300 API mashups. Walmart, by contrast, has only one API that has yielded only one mashup. When you run standard network algorithms you find that Amazon sits near the core of the API economy whereas Walmart is at the periphery.   While Walmart still beats Amazon in overall sales, it is far behind Amazon with less than one-sixth the online sales. Amazon's revenue is also growing faster, with year-on-year growth from 2013-2014 of 20 percent compared to 1.9 percent for Walmart. While there are a variety of explanations for these results, the differences in APIs strategy provide valuable clues contrasting approaches to innovation and customer engagement.[4]

API Economy Visualized: Amazon vs. Walmart

Note: Today, there are over 10,900+ APIs, 6,000+ mashups, across 100's of categories ranging from search and e-commerce to transportation, tools, and enterprise. This visualization has been filtered to focus only on core APIs. The results in roughly 4,000 APIs or 37 percent of the total presented.

Source: Rahul Basole and Peter Evans, with data from ProgrammableWeb, Center for Global Enterprise, 2015

This is not to say that retailers do not actively use or provision API tools and services to support a range of approaches aimed at optimizing and personalizing device and screen experiences. They do. Macy's has tapped Twitter's Audience Platform to reach more customers and boost sales. However, the number of open APIs that Macy's itself has established is very small. Among this small number, only one API mashup has been established. A similar story is true for other major retailers as shown in the chart below.

Amazon by contrast has a large and growing number of open APIs. This is true in the eCommerce space where there are now 140 mashups built on Amazon APIs. However, Amazon is clearly branching out beyond eCommerce into other areas such as cloud, enterprise tools, mapping, messaging, networking and payments. These are fundamental information infrastructure services for the Internet of Things. As a result, it may be important to consider whether it will be necessary to reclassify Amazon's industry peer group.

API Mashups: Amazon vs. Other Major Retail Enterprises
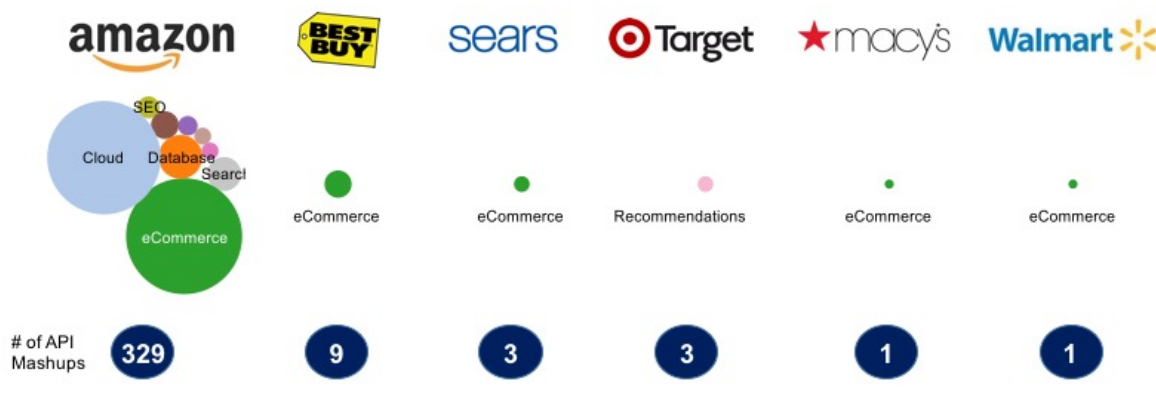
Source: Rahul Basole and Peter Evans, with data from ProgrammableWeb, Center for Global Enterprise, 2015

Exploring the evolving e-Commerce space is just one of the areas that visual analytics can shed light. Other areas in which open APIs are producing large numbers of new information exchanges between firms include images, video, search, messaging, data storage, financial services, work, telematics, and a range of enterprise services.

The API economy is forcing change at the firm level. Observers like Tom Davenport have pointed to the need for IT functions to adapt.[5] It is no longer about just maintaining internally focused email and websites or managing inbound traffic from customers. Rather, he argues, enterprise IT needs to become more open and strategic aimed at using APIs to build external ecosystems.

More broadly, the API economy is creating a new class of companies that are using API strategies to supply infrastructure services

for the Internet of Things (IoT). As information and data make up the core of IoT, APIs are becoming an important means of making the IoT a reality. The new emerging group can be thought of as IoT infrastructure companies.   API mashups help electric vehicle owners find charging stations. An application like PlugShare, which is built on top of Google mapping API, connects electric vehicle drivers to charging stations and to a community of other electric vehicle users. The application services over a million queries a month using the map function to locate and input re-charging facilities. Another example is, a mashup between DocuSign's electronic signature technology and PayPal's electronic payment platform. This alliance at the API level makes it easier for other businesses to collect payments from customers, partners, suppliers, and others without the cost and hassle of programming, coding, or other IT involvement.

Visual analytics can reveal the structure and dynamics of this rapidly changing landscape as well as identify first movers. In 2006 there were roughly 350 public APIs. Today there are nearly 11,000 representing a thirtyfold increase over a decade.   The pace of API development and the creation of innovative mashups show no signs of slowing. While the exact numbers are not known, some industry analysts estimate that there are three times as many private APIs as the number that are made public.

With this rate of change and new patterns of interaction that is being created, it is important to have tools that enable understanding and sense making of this complex ecosystem. Visual analytics provides powerful means to keep pace with these developments and trends. These techniques can also reveal the specific network patterns that are at work in shaping the 21st Century enterprise.

[1] Bala Iyer and Mohan Subramaniam, "Corporate Alliances Matter Less Thanks to APIs," *Harvard Business Review*, June 8, 2015.

[2] Roberto Medrano, "Welcome To The API Economy," *Forbes*, August 29, 2012.

[3] See ProgrammableWeb, http://www.programmableweb.com/

[4] Walmart has recently announced efforts to bolster its ecommerce strategy. The extent to which it will rely on open APIs remains unclear. See: Hiroko Tabuchi, "Walmart, Lagging in Online Sales, Is Strengthening E-Commerce," *New York Times*, June 5, 2015.

[5] Thomas H. Davenport and Bala Iyer, "Move Beyond Enterprise IT to an API Strategy," *Harvard Business Review, August 6, 2013.*

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