Flink Notebook

Interactive power of Flink Streaming

Spring 2015

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Interactive power of Flink

I. Introduction

1. The business idea

In the last few years Big Data generated a lot of buzz along with the launch of several successful big data products. Thanks to contribution from open source community and several giant Internet companies, the big data ecosystem has now reached a tipping point, where the basic infrastructure capabilities of supporting big data challenges and opportunities are easily available. Entering the next generation of big data - so-called Big Data 2.0 - two of its concentrated areas are Velocity and Applications, besides Data Quality. The cause for the former is that data is growing at an exponential rate and the ability to analyse it faster is more important than ever. For instance, sensors can generate data on millions of events per second and store all of those data and response in real-time is non trivial. The latter is helping to overcome the technical challenges of existing frameworks by making them easy to use and understand for everyone to benefit from big data.

As a result, the demand for ***streaming processing*** is increasing a lot these days. Processing big volume of data is not sufficient in the cases that infinite streaming data is arriving at high speed and users require a system to process fast and react to any incident immediately. In addition, although hardware price has plunged year over year , it's still expensive to equip a storage which is growing few terabytes every day for batch analysis. Streaming processing solutions are designed to handle high volume in real time with a scalable , high available and fault tolerant architecture. This enables analysis of data in motion.

One of the disadvantages to users is that many big data framework provide a rich imperative API codes only to process data stream on the fly. First, user must spend time learning API documentation properly since those APIs is fairly new to them. Therefore, the life cycle to develop products taking longer. Second, given that most big data applications are fairly simple application-wise, a block of API codes might be less optimal to use for most the popular queries. Third, the only way to share your work is to pack it as a library or service which is need to be deployed again. Fourth, the results

of streaming queries are keep changing upon the time. Thus, it demands a visual way to monitor the streaming instead of concrete array of numbers. Those above drawbacks apparently provide an unfriendly UX that inhibit both productivity and system performance. It is really against what we expect from "Application" aspect of Big Data 2.0.

We would like to promote "Flink Notebook", an interactive, collaborative web-based interface on top of Apache Flink which provide a complete streaming processing. Flink Notebook brings to developers a friendly, effective environment without scarifying the power of Flink Streaming.

Basically, Flink Notebook allows users to write standard SQL queries on webpages. The notebook issues corresponding commands to Flink to make it operate continuously on data as they arrive. The result is updated incrementally in real-time and displayed on Notebook with visual aid. In short, users need to know nothing about Flink API, except for very common SQL basis. The result is also brought to life by a powerful visualisation web pages.

Flink Notebook facilitates the productivity by allowing several colleagues to collaborate on the same notebook on the same work in real-time despite the physically location differences. The work can also be captured and exported to a portable format which can be viewed shared , restored later at ease.

2. My research background

Hint: just very shortly, why is it important, what happened before

// existing tools in Complex Event Processing (other name ? Marton), why still growing

During my 3-month internship I am working on Design and Implement an SQL dialect for Apache Flink, parts of the topic is related to online and streaming data processing and user UX. I realise an eager needs of a new application , which is presented in this minor thesis, to engage developers into building Big Data applications.

Streaming Processing is not a new concept. Indeed the similar concept, Complex Event Processing (CPE) had been proposed from the 1990s by Event Simulation Research at Stanford [1]. Since that time, people have started generating a lot of different buzzword around it [2] and often reinventing ideas borrowing from other fields , but using a different vocabularies to describe the same concepts. Basically , the idea is to

analyse one or multiple data streaming to identify meaningful events and respond to them as quickly as possible.

According to CEP Tooling Market Survey 2014 [3], from 1996, there were more than 30 companies providing Streaming Processing solution. All the major software vendors (IBM, Oracle, Microsoft, SAP) also have good to excellent offerings in the CEP space for customers.

However, since a massive amount of data is growing rapidly every second, Hadoop is emerging distributed processing ecosystem today. Thanks to Hadoop, people can build a large scalable distributed system on Cloud. Even though Hadoop is designed to[1] [2]scale up to thousands of machines with very high degree of fault tolerance, it is optimised to run batch jobs with a huge load of computation. Because of time factor, Hadoop has limited value in online environment where fast processing is crucial. Therefore, existing CEP solution is barely compatible with Hadoop ecosystem. We demand a new sort of streaming framework which is able to integrate on top of Hadoop system. Apache Flink is one of these frameworks.

In term of cooperative work, iPython Notebook is web-based interactive environment where one can combine a working session into a single document. The document can be shared and converted to other common formats such HTML, pdf for quick review. Google Docs allows multiple users to collaborate on a document in realtime. Our Flink Notebook inherits both of these technologies to provide an interactive, collaborative environment along with super power of Flink.

3. Method to use in the Thesis

Hint: very shortly: literature review, some interviews, company consultations, my own major thesis research to use

YOU SPEAK HERE ABOUT A PROPOSED PROJECT. USE PROPER WORDS TO MAKE IT CLEAR THIS IS ONLY A PORJECT PORPOSAL: HERE YOU WILL NOT DEVELOP ANYTHING!

A project developing Flink Notebook requires us to have a deep understanding on Flink Streaming , interpreter theory and web programming skill. First, we study the principle of Stream Processing and data flow in Flink. Second, we need to design SQL-like syntax which user can use to issue command to Flink. Third, a web application helps to interact with user.

The project involves many big data developers during design process. According to regular project management methods , we have to observer , to monitor their behaviour during testing , also we need to interview them for valuable feedback.

[1] Hadoop is a free, Java-based programming framework that supports the processing of large data sets in a distributed computing environment. It is part of the Apache project sponsored by the Apache Software Foundation

Finally, to shorten the developing cycle, we take the advantage of community to integrate many open source project into ours

II. The product environment

Present a short, concise, selected analysis of existing research which is relevant to your topic. It has to justify how your investigation may help answer some of the questions in this area. Your thesis review can't be a straightforward summary of everything you have read on the topic or even a chronological ("monographic") description : keep it in form of 2-3 main articles / models and use max. 3-4 more specific papers.

Important: After citations of 2-3 articles, opinions, results, please compare and criticize the information collected — contrast your approach, stress weaknesses or strengths in their methods used, findings published around, etc.

Hint:

literature research on compilers / streaming data and referring to the major thesis;

Software development methodologies, comparison to these;
1-2 GENERAL articles and 2-3 SPECIFIC ones to this topic;
have an opinion summarised about these articles

just place a short history plus definitions here; referring even to common textbooks

1. Data Stream
2. Continuous Query Language
3. CQL for Flink

III. Marketability of the Idea

1. Market Needs

First and foremost, we take a glance on Big Data promising forecast in global market. According to well-know IDC forecast [4], the big data and analytics market will reach *$125 billion* worldwide in 2015. Rich media analytics such as video , audio and image will contribute as a crucial driver to prompt a rise in big data applications. 25% of top IT vendor may announce Data-as-a-Service solutions based on expanding cloud ecosystems (expected to reach $118 billion in 2015).

One of the major business lines, which could not be adopted successfully without Stream Processing supports, is Internet of Things (IoT). IoT back end as a service (BaaS) will emerge and require a mature Stream Processing platform. Expenditure on IoT may exceed $1.7 trillion, up 14% from 2014 and go up to $3 trillion by 2020 . In other words , it is growing with a five-year CAGR of 30%. Therefore, we expect IoT would bring a huge slice of the cake to Stream Processing in revenue and development.

How organisations embrace the Big Data trending? The report 'Big & Fast Data: The Rise of Insight-Driven Business' conduct by *Capgemini*, surveyed 1,000 senior decision makers in nine regions and nine industries. It reveals the fact that 65 % of organizations acknowledge they are at risk of becoming uncompetitive unless they embrace new data analytics solutions. Specifically , accessing Big Data faster is where C-suite executives see the most value – 77 percent state that decision makers increasingly require data in real-time. However, More than half (52 percent) of respondents reported that developing fast insights from data was hampered by limitations in the IT development process.

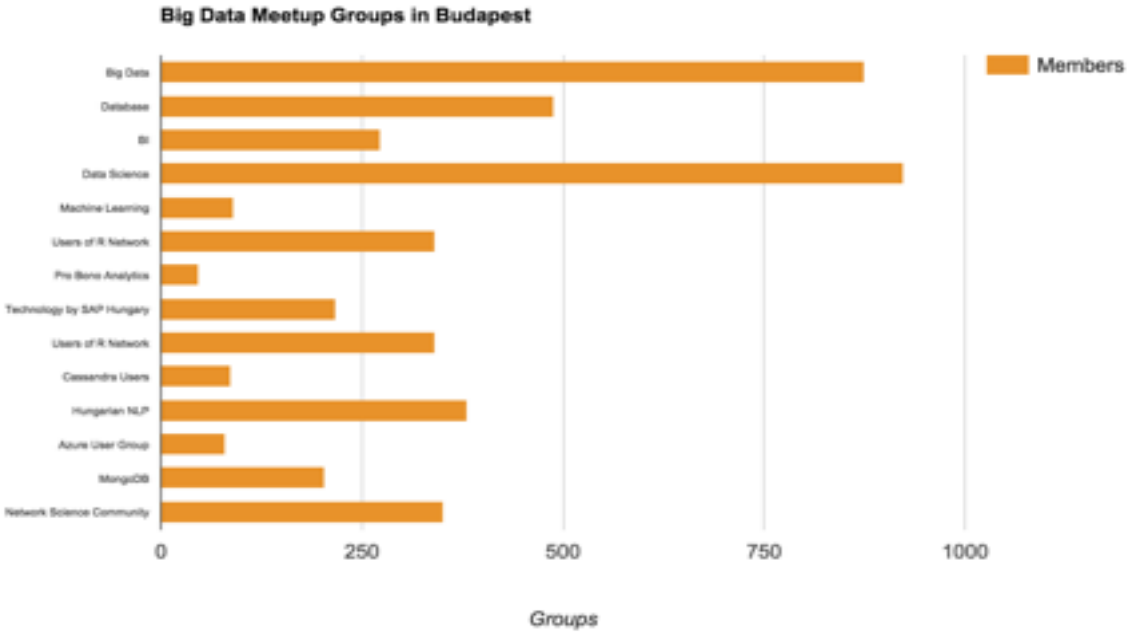
In short, the market is in strong demand of real-time Big Data Platform , along with supported tools to provide better development process.

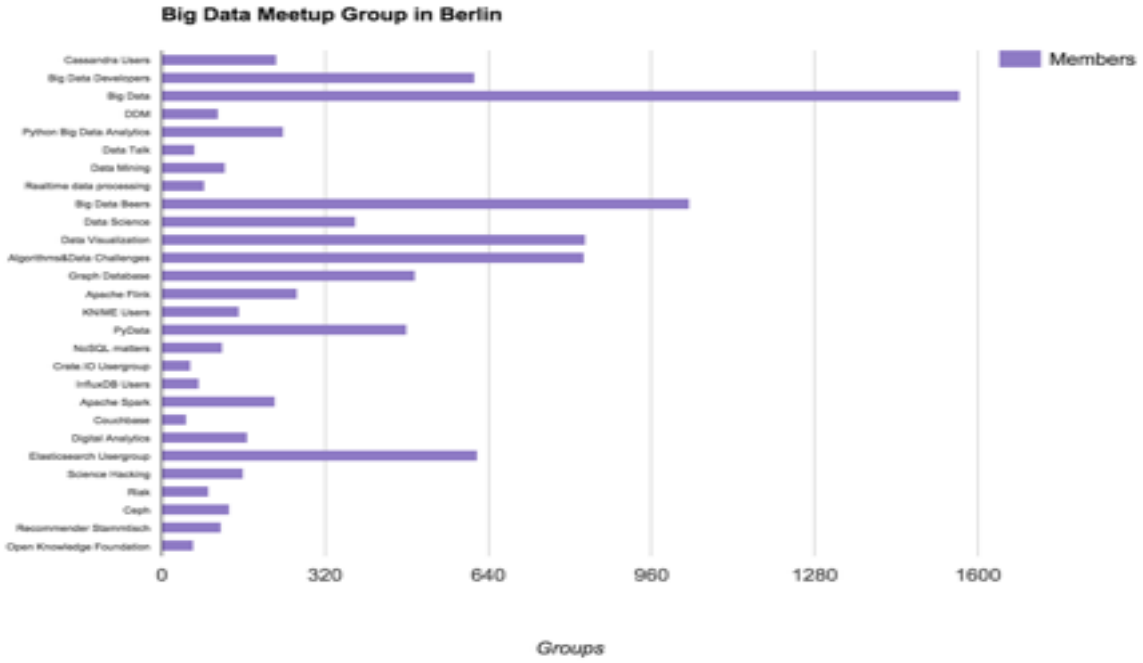
We are going to supply services to the German and Hungarian market at the beginning. The hint is that our teams are based on Berlin and Budapest so that we are capable of nurturing our initial market at the beginning. Even though the German Big Data market still appears to be at an early stage, it is expected to from EUR 650 million in 2013 to almost EUR 1.7 billion in 2016. Additionally, Software and Services would account for 70% of that value.

We did a research on [3]*Meetup* groups using their API to see how active Big Data and Data Analytics community is.

In Berlin, we found about 30 Data-related groups with more than 9300 members in total. In Budapest , we are also able to reach about 4700 members in total. Even each developers can join more than 1 group but the number is till quite considerable.

[3] http://www.meetup.com

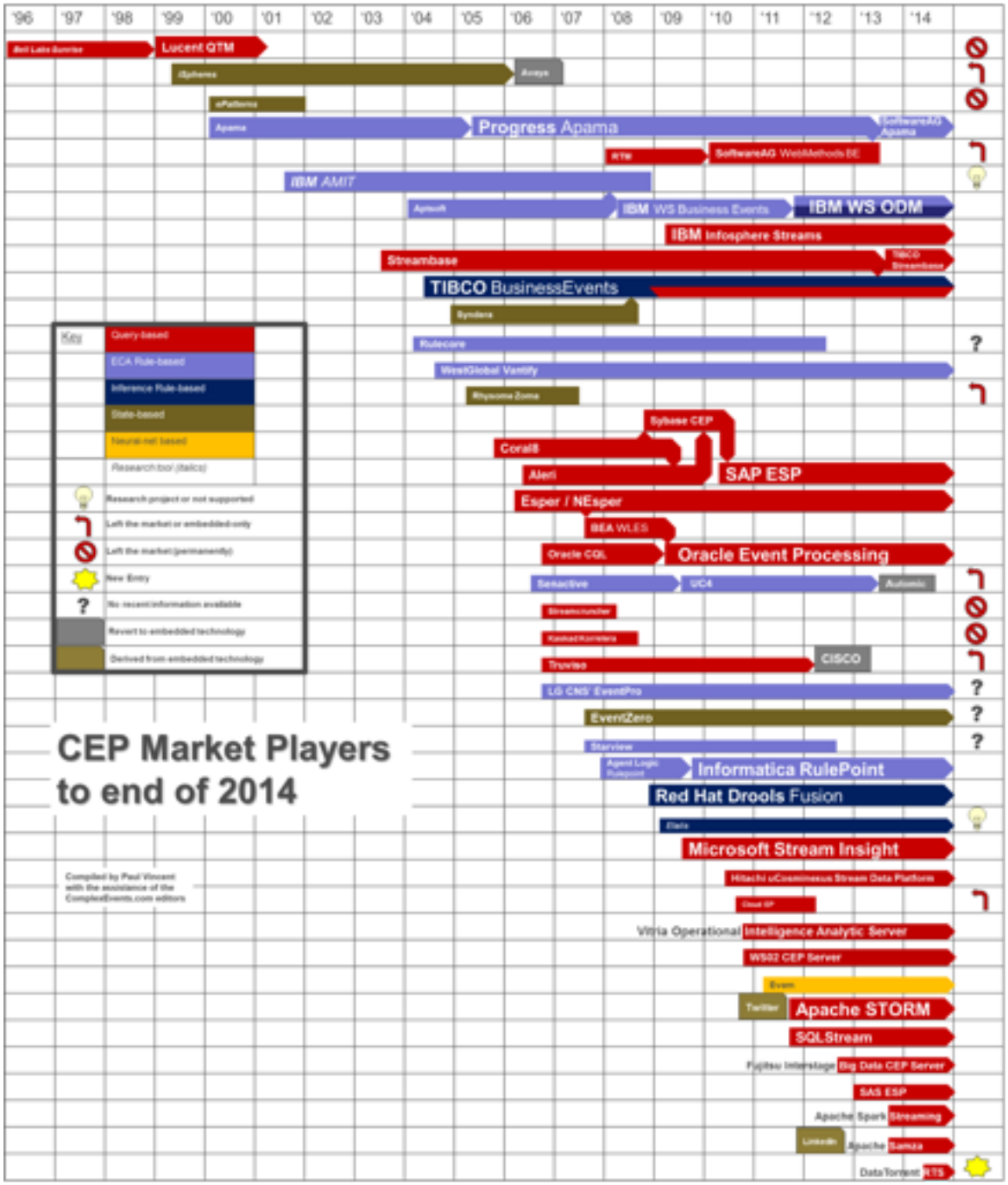

Big Data Meetup Groups in Budapest
Members
Big Data
Database
BI
Data Science
Machine Learning
Users of R Network
Pro Bono Analytics
Technology by SAP Hungary
Users of R Network
Cassandra Users
Hungarian NLP
Azure User Group
MongoDB
Network Science Community
0
250
500
750
1000
Groups


Big Data Meetup Group in Berlin
Members
Cassandra Users
Big Data Developers
Big Data
DDM
Python Big Data Analytics
Data Talk
Data Mining
Realtime data processing
Big Data Beers
Data Science
Data Visualization
Algorithms&Data Challenges
Graph Database
Apache Flink
KNIME Users
PyData
NoSQL matters
Crate.IO Usergroup
InfluxDB Users
Apache Spark
Couchbase
Digital Analytics
Elasticsearch Usergroup
Science Hacking
Riak
Ceph
Recommender Stammtisch
Open Knowledge Foundation
0
320
640
960
1280
1600
Groups

2. **Competitors**

According to the CEP market players to end of 2014, conducted by Paul Vincent and his team, CEP tools have a long history but many of them are acquired or left the market. Almost tools and platform support query languages which we also provide.

Even all the major and medium software vendors offer their own solution but we target to the open source community with some emerging top projects such asApache Storm , Apache Spark and Apache Samza.



We briefly compare those tools to our solution in term of Streaming Processing [6]:

	Storm	Spark	Samza	Flink	(note)
Delivery Semantics	>1	1	>1	1	smaller is better
State Management	Stateless	Stateful	Stateful	Stateful	stateful is better
Latency	sub-second	second	sub-second	sub-second	smaller is better
Language support	Any	Scala, Java, Python	Scala, Java	Scala, Java	more is better
Query Language Support	Yes	Yes	Yes	Yes	
Notebook features	No	No	No	Yes	

*Notebook features: collaborative, interactive interface ; file format to share

3. Value proposition

Hint: what we can offer
We would offer a difference to the above products; it will be a
- compiler, easy-to-use; more effective, etc etc
- a „Notebook" to use as a manual

Customer pains:

Working on most of the existing Big Data frameworks, developers encounter several disadvantages:

- They need to spend time learning API via documentations. The API is non-standardized and may not be well-designed , thanks to the committers' expertise. In addition , for most popular user-cases, the programs are conducted from API by developers may be less optimal in term of time and space cost.

- Result from querying data stream is continuously emitted, users is hard to observe the change to react

- It is not easy to share your work s with colleagues except for packed library or services with additional documents

Customer Gains:

- All of developers is familiar with SQL syntax which is widely adopted as a standard for data query language. Therefore, i would be much more efficient if they could issue command to Bigdata application using SQL-like syntax. No much effort to learn that syntax
- A visualized output would make users easier to examine and monitor the flow of data
- Developers wish to have a portable file to wrap up their work, share to people and show how the output is expected. Need not to recompile the program.

Products and Services

To relieve our developers' pain and accelerate their work, we would like to introduce Flink Notebook with several advanced features:

- It is a web-based UI environments helping users interact with Flink platform. As long as we are able to connect to Flink, we can run Flink notebook *everywhere with a browser*.
- Command the system with SQL syntax
- An interactive UI : users are able to type their command and receive the result as real-time charts
- Flink notebook save your work (commands and visualized outputs) to a portable **.fnb* file. We can *export* it, *hand over* to colleagues. They co*uld open the file at ease in any browser.* If your machine do not connect to Flink infrastructure, you can see all of issued command and its output non-interactively. Otherwise, you are empowered to re-run all of authenticated command and observe new results.
- Users can invite other people to work on the same *.fnb format collaboratively regardless of different physical location.

IV. The project proposal

1. The project idea

Hint: Repeating in details the starting text: why is it beneficial for the company to have this development

// Big Data

Big Data Use cases: activity - business process - industry

[Big Data]IDCReport-WorldwideBigDataTechnologyandServices.pdf

Big Data Services.png

// streaming

Streaming Service.png

Fundamental of Stream Processing

// Flink notebook

Useful tools are largely lacking for very large data sets. Tools such as Hadoop and MapReduce can effectively expedite searches through the large, irregular data sets that characterize some of the newer Big Data problems. Scientific users tell IDC that these tools can be great for retrieving and moving through complex data, but they do not allow researchers to take the next step and pose intelligent questions

Sophisticated tools for data integration and analysis on this scale are largely lacking today. There are opportunities to create tools and applications for Big Data. Vendors that create tools and applications for use at this scale can use them as a lever to seize market leadership positions in the Big Data market.

2. [deleted] Channels to build a user community on these markets

build a network of consultants and partners to support your technology

3. [deleted] Contacting customers: customer relationship solution, promotion

4. The company background

Hint: here you can write about the company, today product portfolio, etc
why they are interested in a new product

// DataArtisan

Very few sentences, maybe a corporate organisational chart to understand where to "place" your project, what do you propose : which type of people from the organization could take part in the project?

5. Feasibility

Hint: Activities and resources needed for the project
SOME SENTENCES ABOUT PROJECT MANAGEMENT; ICT projects;
development process: resources (mandays, experts, software to use,
hardware needs, time, money, etc.
Marketing / promotion activities: building a website; pricing the tool
compared to other tools, etc

CREATE A TABLE, A MATRIX HERE FOR SAY, 4 QUARTERS (ONE YEAR PROJECT), WITH ACTIVITIES, KEY FIGURES

6. Project planning

Hint: A simple scheduling of activities (based on list of 3.6.); participants, milestones and deadlines;
all in a visual plan like Gantt-diagram
Management problems: which type of project management is needed

Jira

7. My participation in the proposed "Customer Feedback Subproject Proposal"

Hint: Here you can write some words on what you could do: idea planning, programming, testing, presentation to beta-version users, etc

8. [Delete] Building a brand

Hint: however being small, any possibility to use a partner to be a „branded product"

9. [Revenue Model]

Hint: pricing ideas: there will be a lecture about; building a brand

V. Summary

Hint: What was the target; how I worked, what is the result;
recommendations to many internship company management;
and: What I have learnt form this Thesis Work…

[1] http://complexevents.com/stanford/rapide/

[2] http://blog.confluent.io/2015/01/29/making-sense-of-stream-processing/

[3] http://www.complexevents.com/2014/12/03/cep-tooling-market-survey-2014/

[4] http://www.forbes.com/sites/gilpress/2014/12/11/6-predictions-for-the-125-billion-big-data-analytics-market-in-2015/

[5] http://www.prnewswire.com/news-releases/new-global-study-by-capgemini-and-emc-shows-big-data-driving-market-disruption-leaving-many-organizations-fearing-irrelevance-300047775.html

[6] http://java.dzone.com/articles/streaming-big-data-storm-spark

[8]A Survey of the State-of-the-art in Event Processing

http://www.forbes.com/sites/louiscolumbus/2012/10/15/using-search-analytics-to-see-into-gartners-232b-big-data-forecast/

http://www.gartner.com/technology/research/it-spending-forecast/

http://www.prnewswire.com/news-releases/nosql-market-is-expected-to-reach-42-billion-globally-by-2020---allied-market-research-498476751.html

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http://www.bi.hu/index.html

http://www.bi.hu/2015/03/30/a_bi_platformok_vezeto_szallitoi_2015ben.html

http://bievkonyv.hu/2011/evkonyv.shtml

http://bievkonyv.hu/2011/konferencia.shtml

https://www.pac-online.com/big-data-segments-market-figures-hungary-0

http://www.fujitsu.com/hu/solutions/business-technology/bigdata/

When I was working on Google Apps, we would often hear people ask, "Why launch Google Spreadsheets? It's 20 years behind Microsoft Excel and 200 features short!" They didn't realise that a driving mantra for Google Apps was "It's the collaboration, People!" I have seen metrics, and still experience daily, how Google Apps' real-time collaboration features boost team task productivity by a factor of 10x or more. It is collaboration among team members with diverse skill sets and points of view that yields these large gains in organizational smarts.

To gain a better perspective on how much data is being generated and managed by big and fast data systems, consider the following noteworthy facts [3]:

· According to IBM, users create 2.5 quintillion bytes of data every day. In practical terms, this means that 90 percent of the data in the world today has been created in the last two years alone.

· Walmart controls more than 1 million customer transactions every hour, which are then transferred into a database working with over 2.5 petabytes of information.

· Facebook currently holds more than 45 billion photos in its user database, a number that is growing daily.

. Data volume of global consumer web usage, e-mails and data traffic

6,706PB/mo

Traditional database technologies are failing to meet the ever-increasing storage and analysis demands of big and fast data. The first companies to widely employ big data analytics technologies, the US-based enterprises Facebook, Yahoo, Google, and Amazon, were early advocates of moving away from relational databases because storage costs grow geometrically with the amount of data to be stored and reaches a limit when dealing with data in the range of petabytes

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Company:

Companies
actuated
Alteryx
Applix
Business Objects
Cloudera
Cognos
Comshare
DatAllegro
EMC
Eclipse BIRT
Greenplum
HP
HortonWorks
Hyperion
IBM
Infobright
Informatica
JasperSoft
Jedox Palo
KarmaSphere
MicroStrategy
Microsoft
Netezza
, Oracle
Panorama Software
ParAccel
Pentaho
QlikView
Rapid Miner

SAP

SAS

SPSS

Splunk

Sun

Sybase

TIBCO Spotfire

Tableau

Talend

Teradata,

Vertica

MODIFIED Thesis frame DUY **22nd March 2015**

1. Introduction

   1.1. The business idea: online processing of streaming data needs a new solution,
   a compiler ; the Thesis is offering a **PROJECT** to develop this tool
   terms, short idea

   1.2. My research background
   just very shortly, why is it important, what happened before

   1.3. Methods to use in the Thesis
   very shortly: literature review, some interviews, company consultations,
   my own major thesis research to use

2. Marketability of the idea

   2.1. The product environment: literature research on compilers / streaming data
   and referring to the major thesis; Software development methodologies, comparison to these;

1-2 GENERAL articles and 2-3 SPECIFIC ones to this topic;
have an opinion summarized about these articles

2.2. Market need: existing customer problems
statistical data, how many project, programmers, etc could be interested
„I just focused in the Thesis to the Vietnamese market: product specialities
can be used at approximately XXX. Software development companies in VietNam

2.3. Competitors: similar products and services
List and put into a matrix all known parameters of leading products

2.4. Value proposition: what we can offer
We would offer a difference to the above products; it will be a
- compiler, easy-to-use; more effective, etc etc
- a „Notebook" to use as a manual

3. The ~~Business Model~~ Project Proposal

3.1. The Project Idea
Repeating in details the starting text: why is it beneficial for the company to have this development

3.2. Customer segment, targeted markets
here you can talk about „two specific markets, Italy, VietNam"
or number of small developers, etc etc as you like

~~3.3. Channels to build a user community on these markets~~

~~3.4. Contacting customers: customer relationship solutions, promotion~~

3.5. The company background

here you can write about the company, today product portfolio, etc
why they are interested in a new product

3.6. Feasibility: Activities and resources needed for the project

SOME SENTENCES ABOUT PROJECT MANAGEMENT; ICT projects;

development process: resources (mandays, experts, software to use, hardware needs, time, money, etc.
Marketing / promotion activities: building a website; pricing the tool
compared to other tools, etc

3.7. Project Planning

A simple scheduling of activities (based on list of 3.6.); participants, milestones and deadlines;
all in a visual plan like Gantt-diagram
Management problems: which type of management is needed

3.8. My participation in the proposed „Customer Feedback Subproject Proposal"

Here you can write some words on what you could do: idea planning, programming, testing, presentation to beta-version users, etc

~~3.9. Building a brand MAYBE~~

~~*however being small, any possibility to use a partner to be a „branded product"*~~

~~3.10. Revenue model~~

~~*pricing ideas: there will be a lecture about; building a brand*~~

~~3.11.~~

4. Summary

   What was the target; how I worked, what is the result; recommendations to mny internship company management; and: What I have learnt form this Thesis Work…