SAP (Higher) Education & Research

HANA Student & Learning Analytics

April 2014

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- **Deloitte**
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- Introduction
- Deloitte
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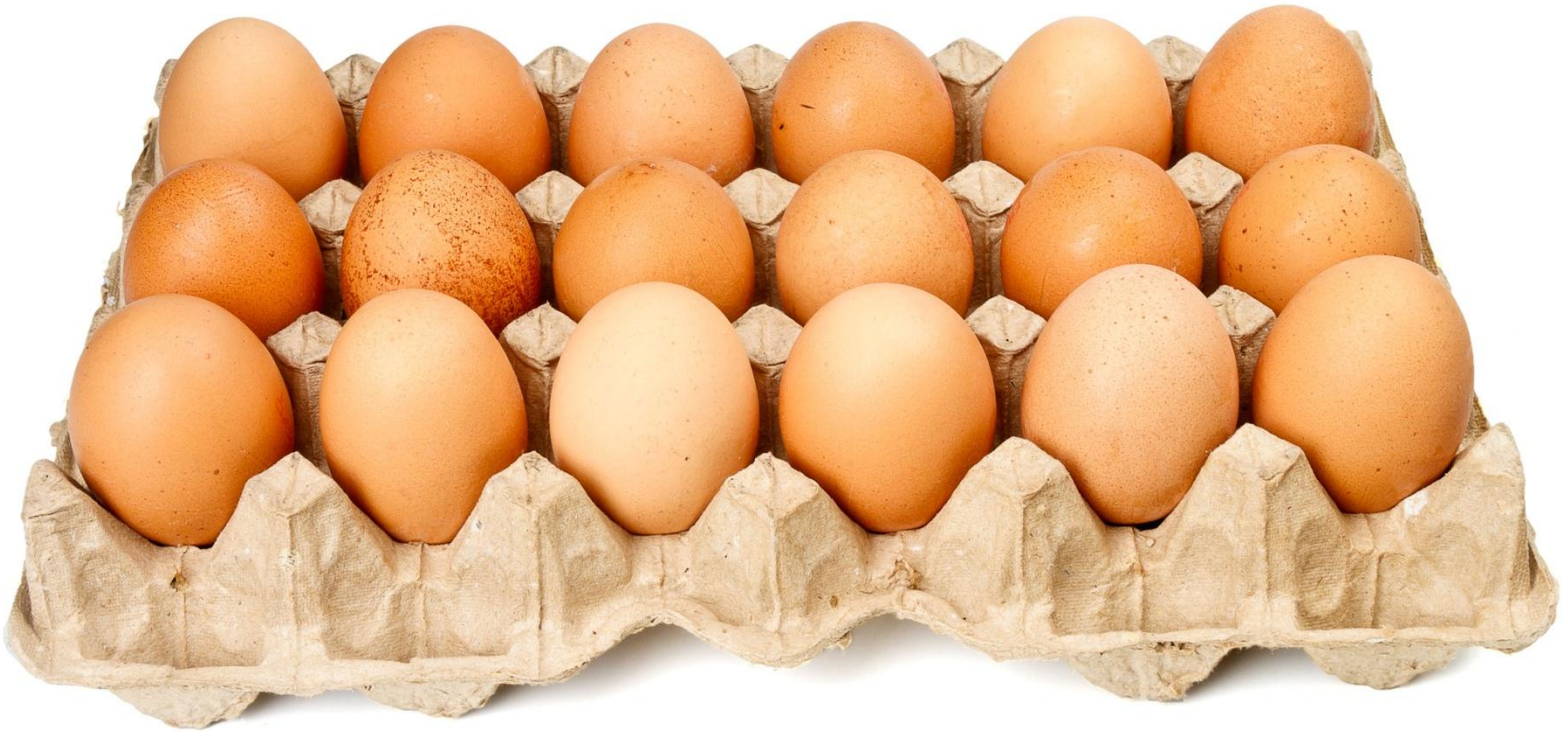
Deloitte.

Student Analytics Services Deloitte

Cornerstone for tailored student counselling

Montevideo, 2014

Determine which eggs have a big chance of breaking and which do not...



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We use a sophisticated visual segmentation technique to zoom in on different types of students: the Self Organizing Map

Imagine all faculty students standing next to each other on the pitch of the Amsterdam Arena...

The assignment:

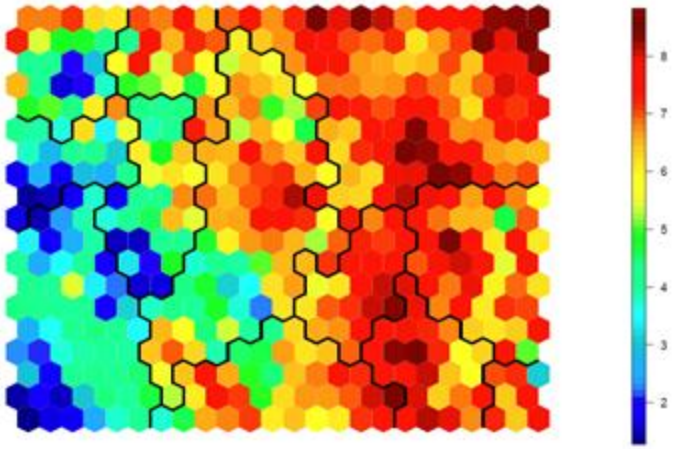
Stand next to the persons who you resemble the most in terms of:

- *study results in the first semester*
- *secondary school grades and prior education*
- *information received*
- *motivation to study*

the students discuss into the small hours of the night and more and more groups start to form.

Coloured flags are distributed late in the morning, a helicopter takes off, and a question is asked:

What was the grade of your first exam?



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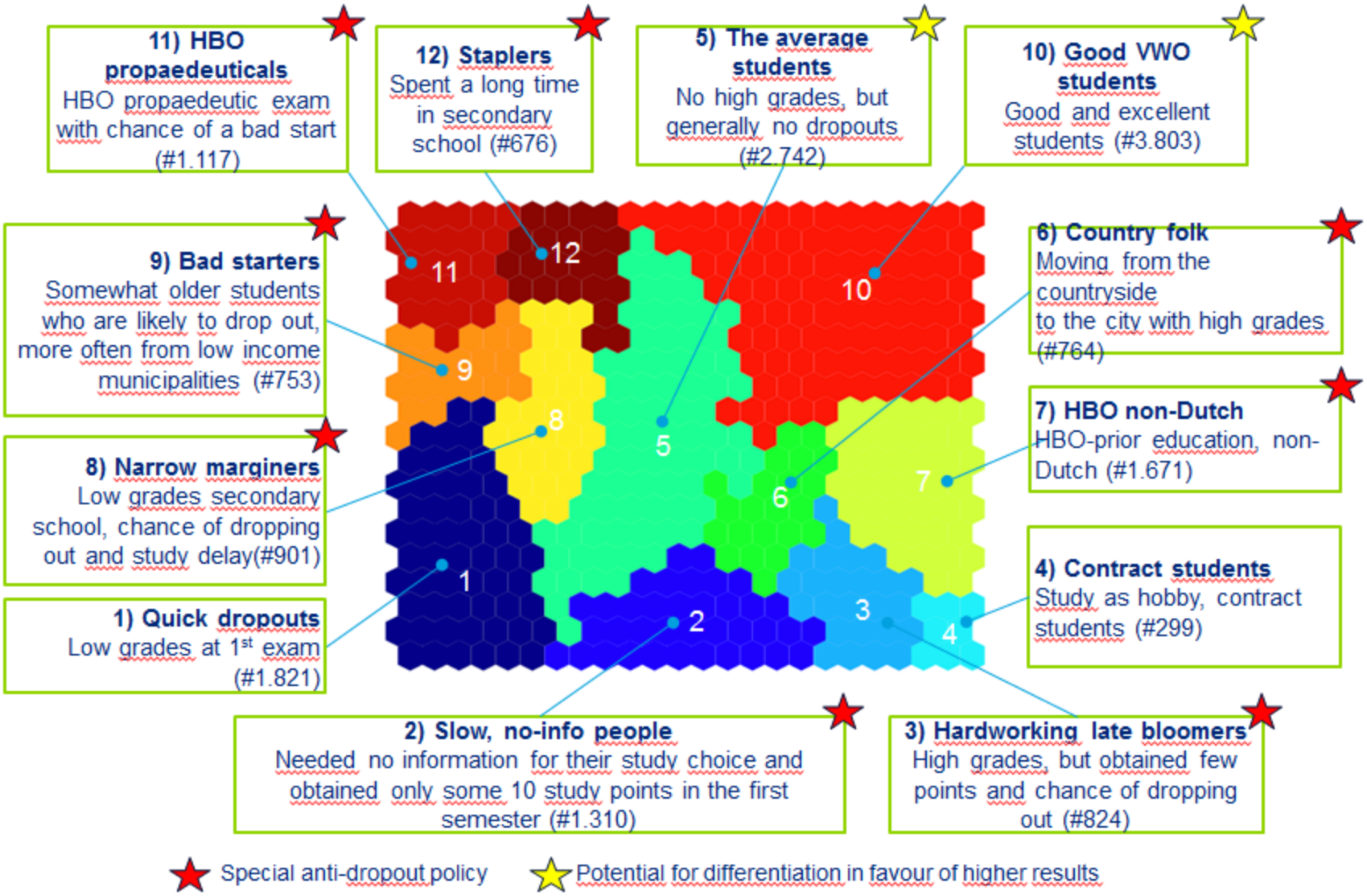
The Deloitte Student Analytics Service offers insight into the chance of study success and the underlying reason



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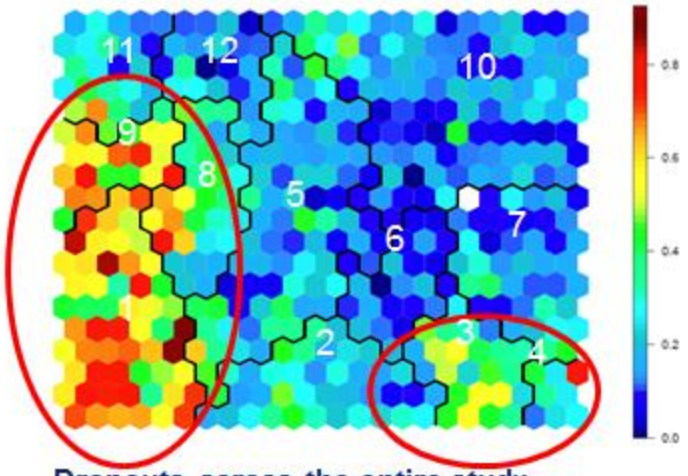
Dropouts are grouped at the left side of the chart in segments 1, 9 and part of 8 and 3

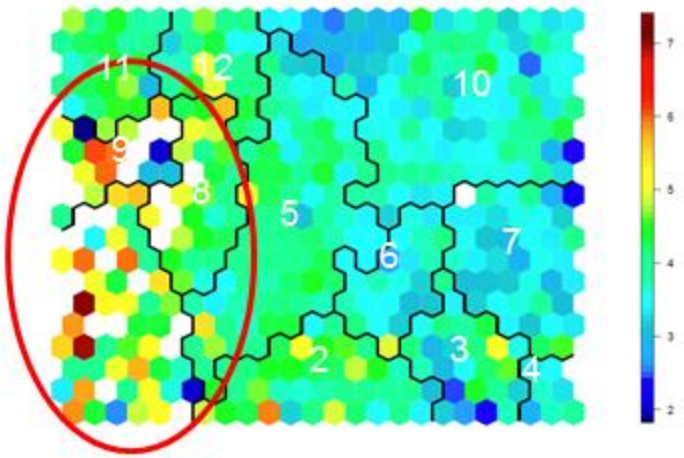
CASE

- (1,3,8,9) Dropouts can be found in several areas; it shows the reasons for dropping out differ.
- (Ditto) Dropouts and delays in years following the first year strongly resemble the first year dropouts.

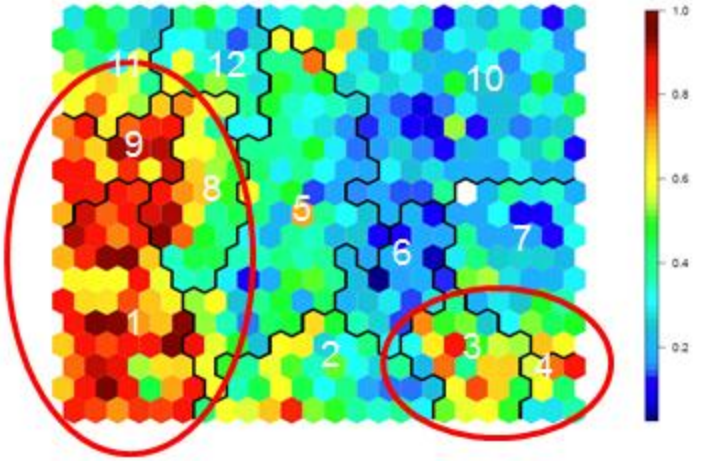
Dropouts within or after one year



Years until exam



Dropouts across the entire study



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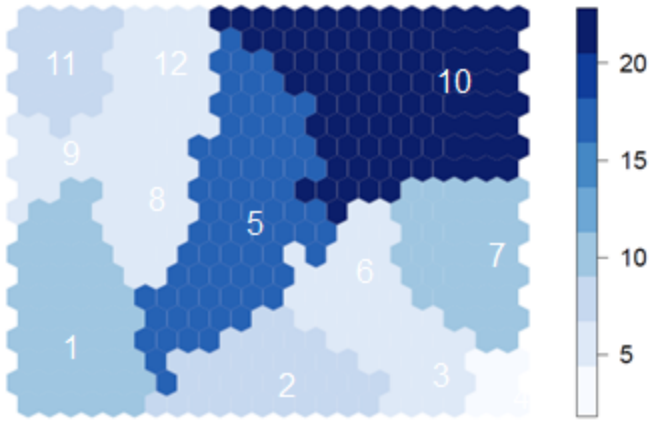
We can aggregate the SOM statistics to segment level as well

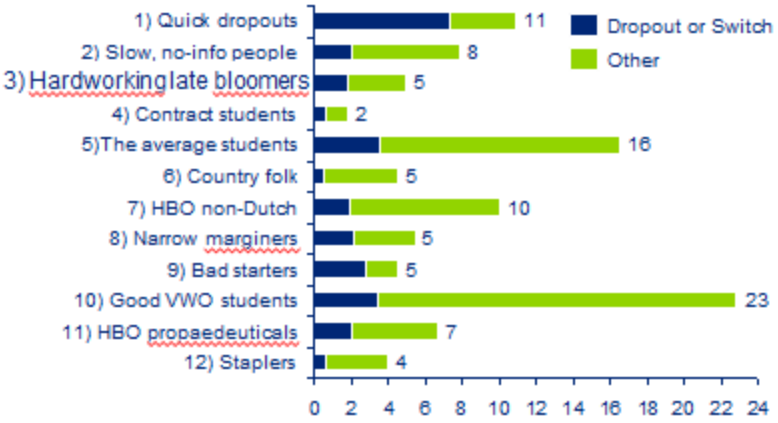
CASE

- The good VWO students (10) and the average students (5) comprise **39% of the population.**
- The HBO segments (7 and 11) add up to **17%.**
- **25% of the dropouts** are classified in the quick dropouts segment.

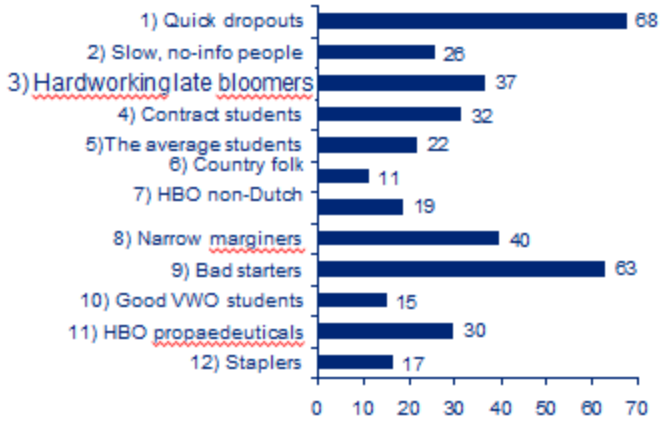
Percentage of students per segment



Percentage of students per segment



Percentage of dropouts per segment



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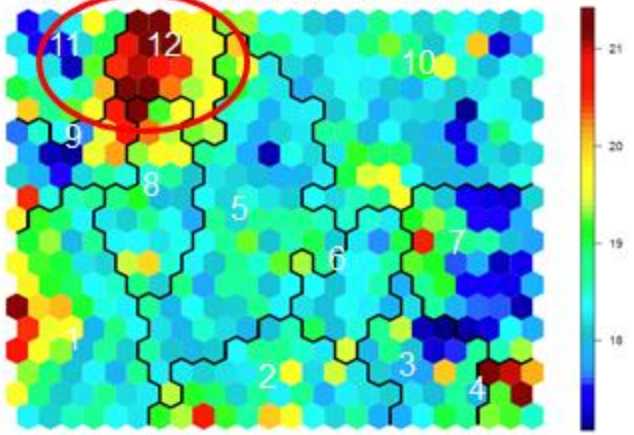
Age during final exam and at start of study

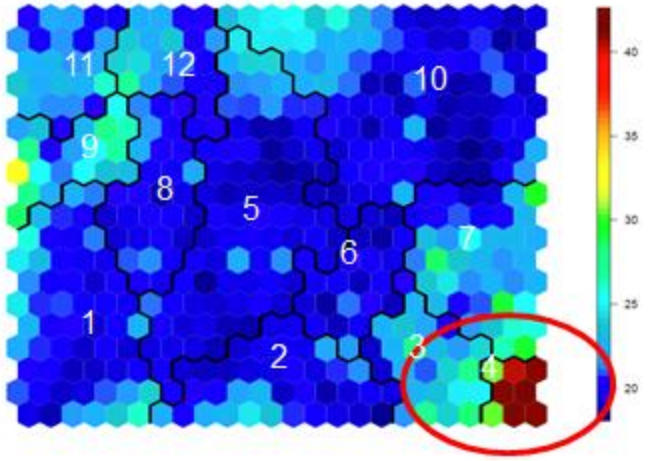
CASE

- (12) Staplers or repeaters in secondary school have a lower chance of dropping out.
- (4) The students include a group of "disguised" contract students, who mostly study for a hobby.

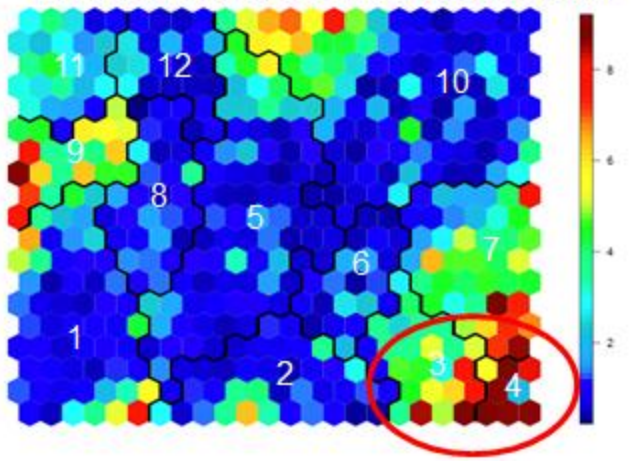
Age during secondary school exam



Age at start of study



Years between start of study and final exam



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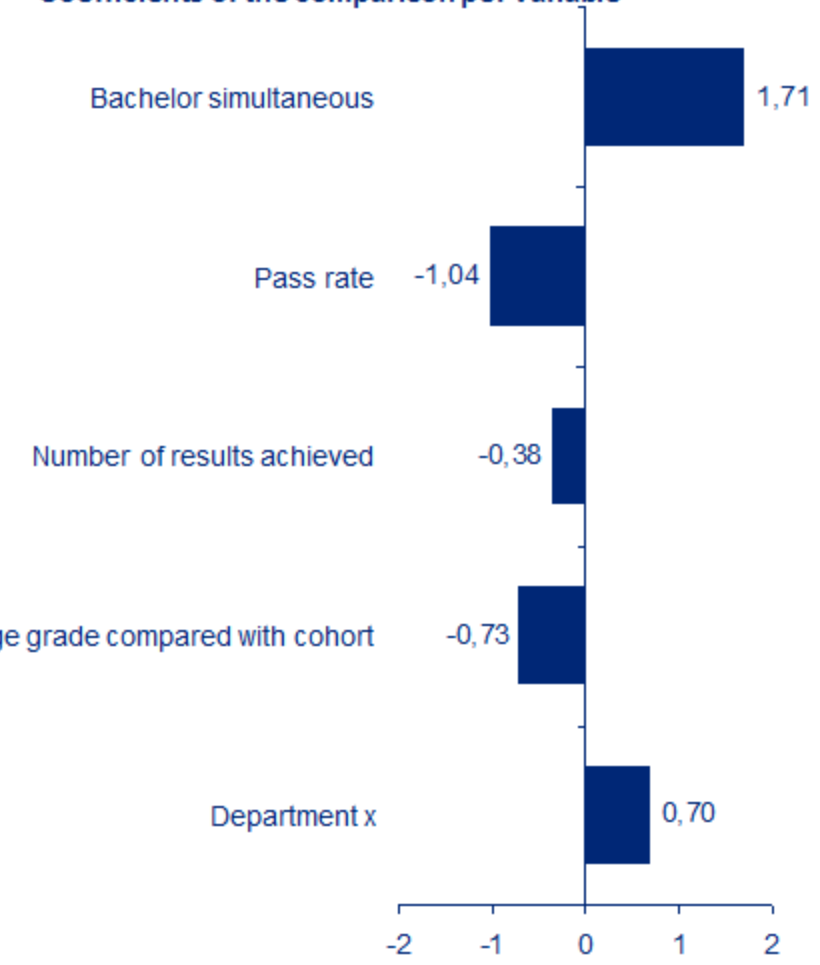
A logistic regression with five variables shows desired characteristics for predicting dropout rates

CASE

- Where the algorithm predicts a student will not drop out, the **chance of dropping out is only 14.1%.**
- When the algorithm indicates a student to fall in the dropout category, the **chance of dropping out is 73.3%.**
- Thus, **this approach is stronger than each separate variable.**
- **New students** can be designated a **chance of dropping out** based on this.
- The coefficient shows which variables (together) positively and negatively influence dropout rate.

		Prediction	
		Dropout rates	Not
Actual	Dropout rates	9.2%	14.1%
	Not	3.3%	73.3%

Coefficients of the comparison per variable



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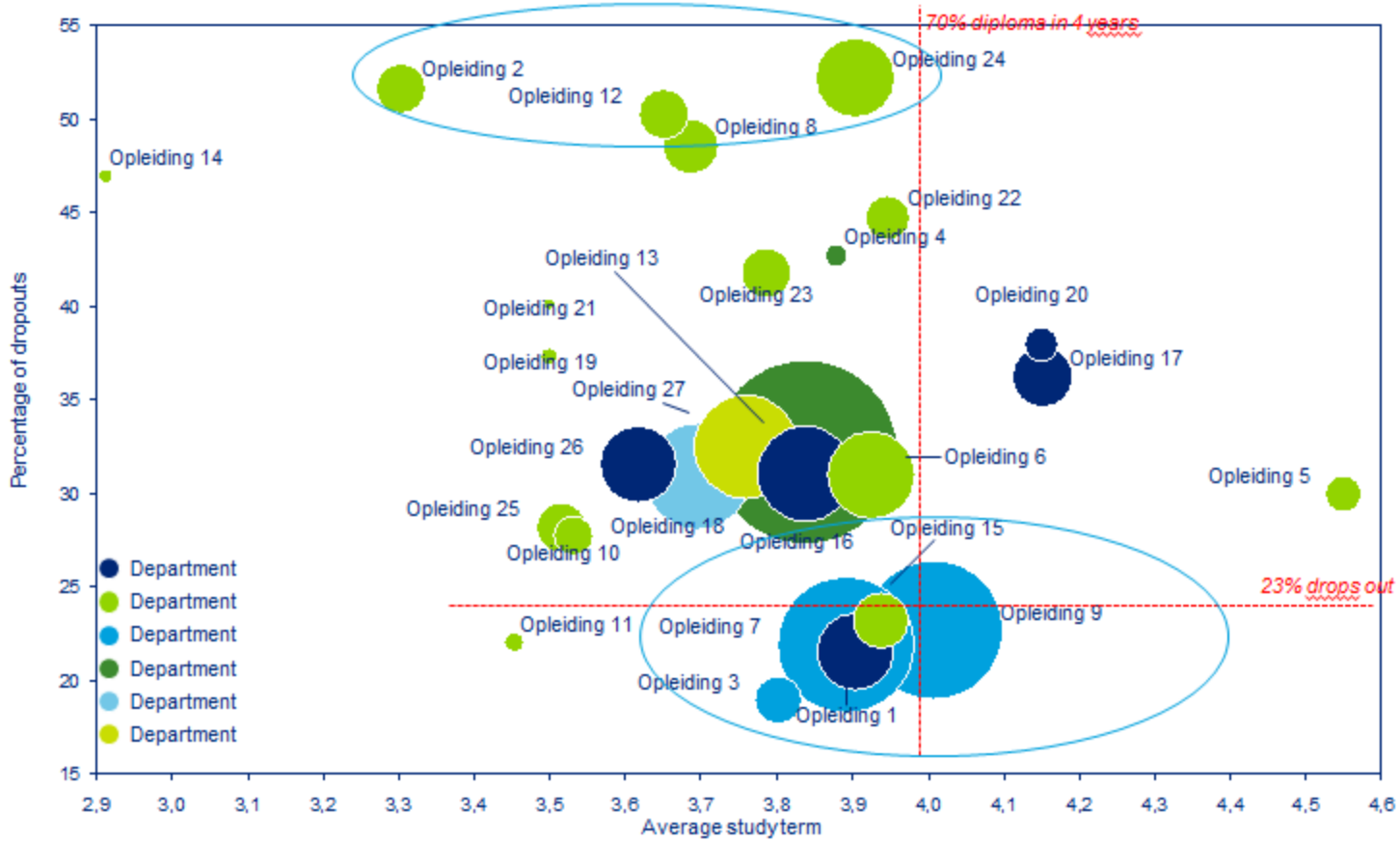
A number of schools with high dropout rate rates have a shorter study term.
A number of schools with low dropout rate rates have a longer study term.

CASE

Division of dropout rates and study term per school



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  - The Situation
  - The Opportunity
  - The Proof-of-Concept
  - The Lessons learned
  - The Next Steps

The Situation

The Situation & The Market (trends)

Big Data

Other saying for student & learning analytics?

- Vast amounts of data kept in different systems like CRM, SIS, LMS, external data sources, etc
- Students leave behind major trails of "*data–something*" information that's ripe for mining and analysis

Increase

Online Learning Environments

- Blended and cyber learning continue to gain a stronghold
- Increasing usage of online learning tools deliver millions of data week-by-week

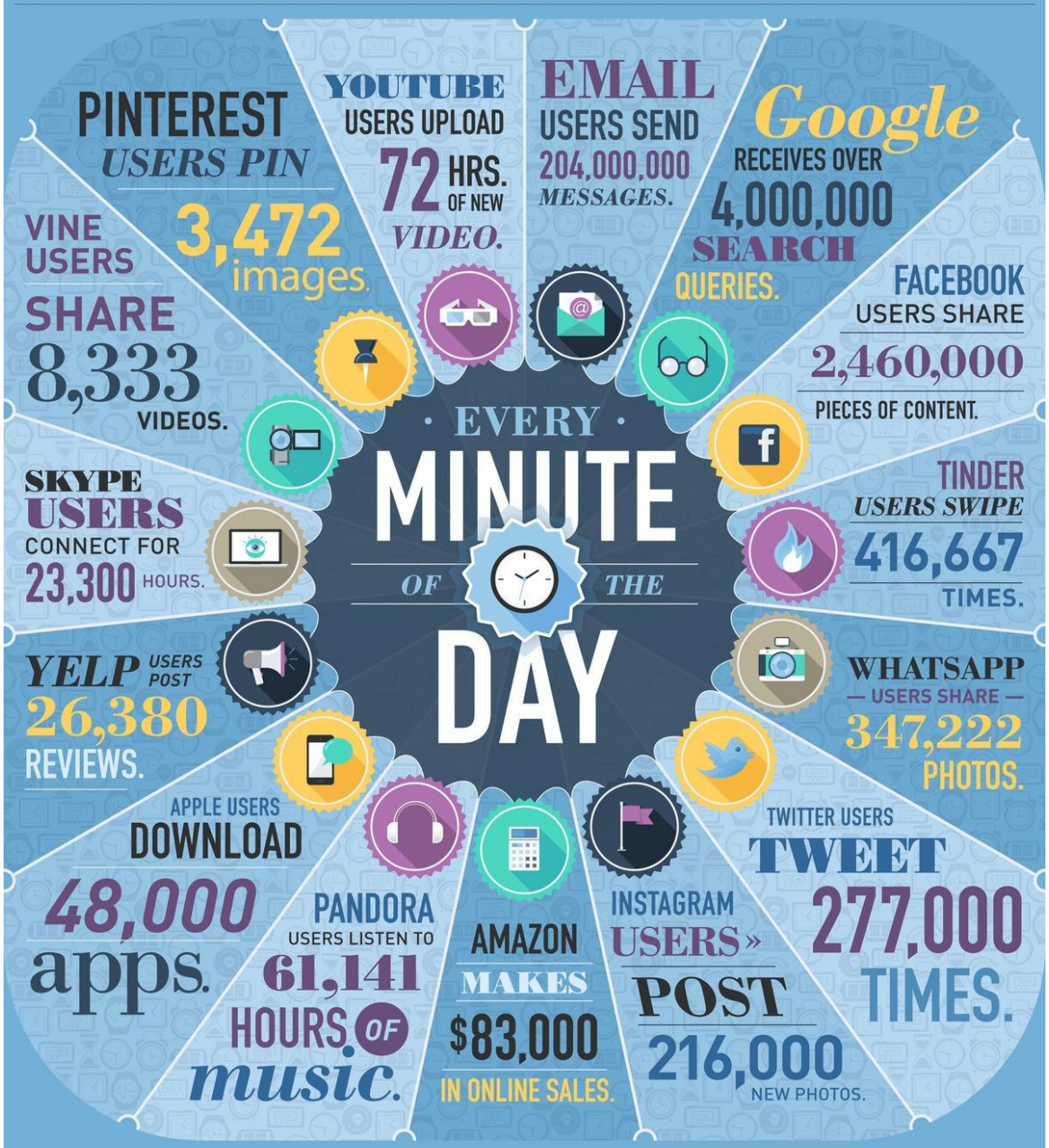
Informed decision making

Student Retention & Engagement

- Enabling management and staff to more effectively manage student engagement & student retention
- Support advisors track student engagement & manage retention

"Advancements in big data and learning analytics are furthering the development of visually explicit streams of information about any group of students or individuals, in real- time"

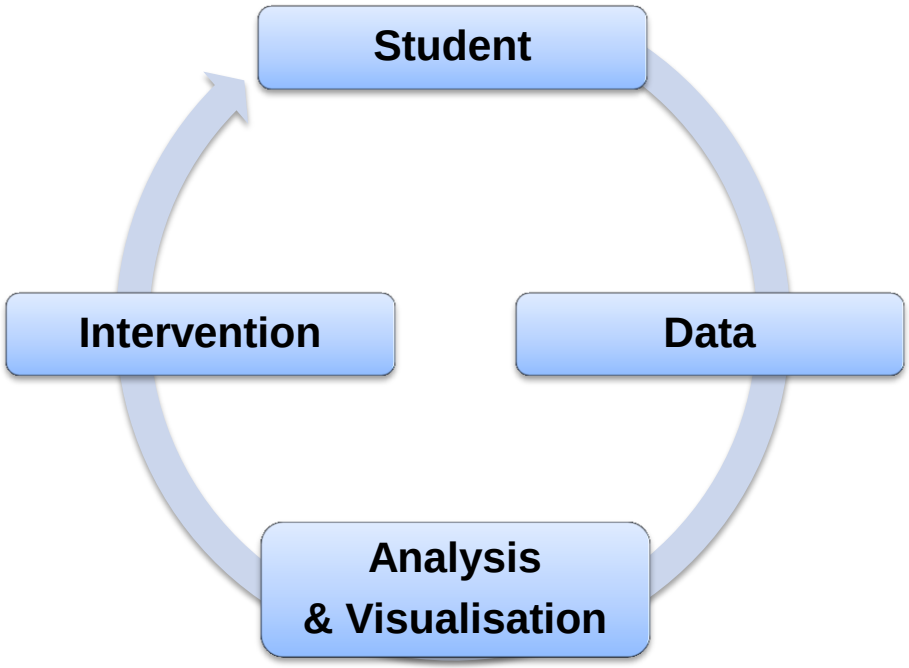
Source: NMC Horizon Report – 2013 Higher Education Edition



THE GLOBAL INTERNET POPULATION GREW **14.3%** FROM 2011-2013 AND NOW REPRESENTS **2.4 BILLION PEOPLE.**

The Situation & the ***hot topic*** of student & learning analytics

"… is the use of data and models to predict student progress and performance, and the ability to act on that information."



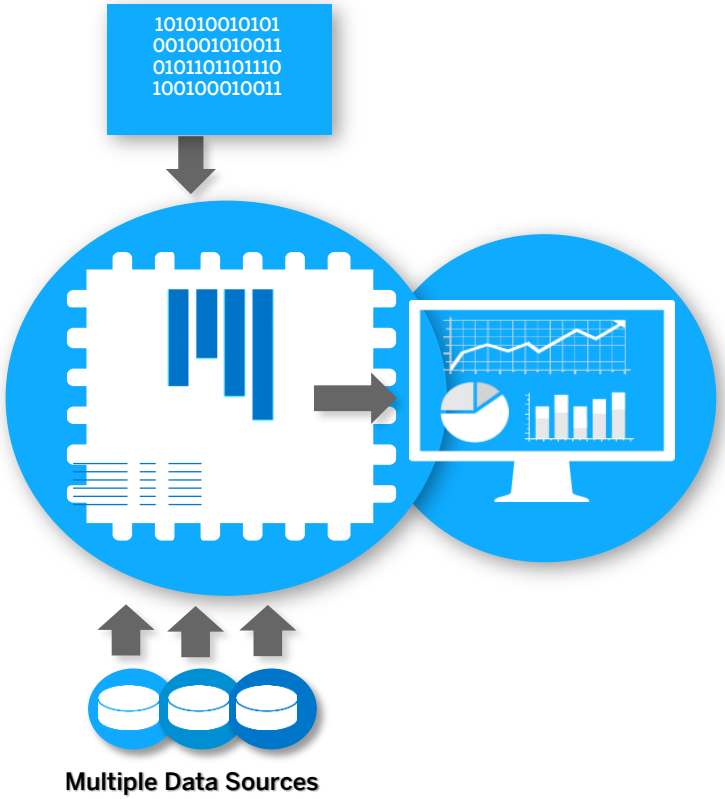
Trending topic

Learning Analytics only recently gained wide-spread support among data scientists and education professionals

Student & Learning analytics can provide valuable insight in:

- Students' learning behavior
- The quality of instruction material
- The use of digital learning management systems
- The quality of assessment and testing
- Individual student performance & progression
- Reasons for early, late, etc drop-out

The Situation & SAP solutions



SAP HANA

Turn Real-time Insight into Big-time Results with SAP HANA as database ‘big data’ engine

Predictive modelling

Predictive analytics with SAP (HANA) solutions allows you to achieve real-time insights that increase understanding of student behavior

Real-time reporting & analysis on live data

Usage of virtual data model with SAP HANA Live delivered via for example Lumira, Business Objects, etc

The Situation & why SAP HANA

To report or not to report …

Limited standard **reporting**, no analytical SLcM reporting in SAP SLcM

Performance

No **load** on transactional Db tables (SAP HANA tables)

Harder, Better, Faster, Stronger

Reporting on (granular) **mass of data**

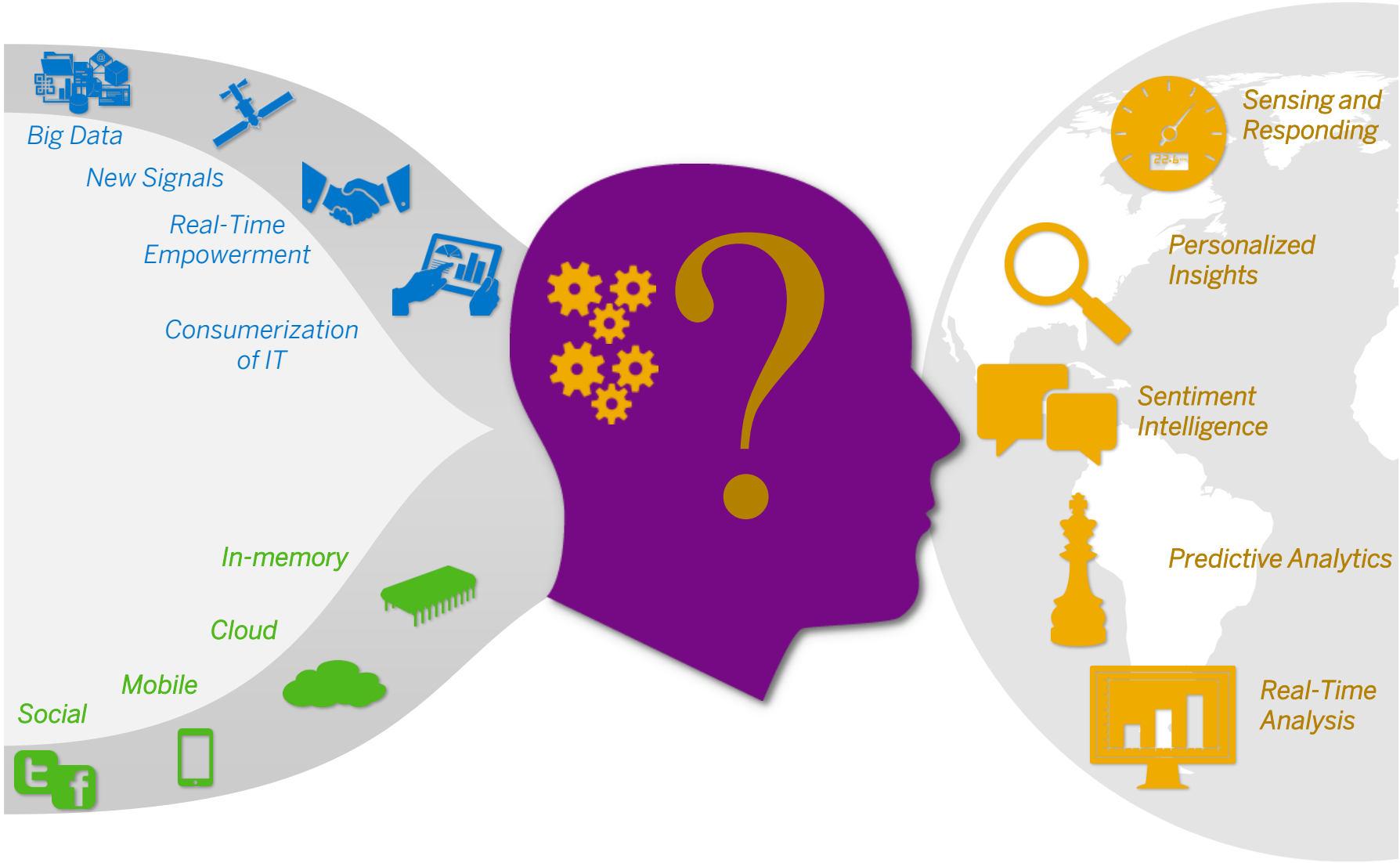
Artificial intelligence

Predictive analysis **library** (eg. KNN model)

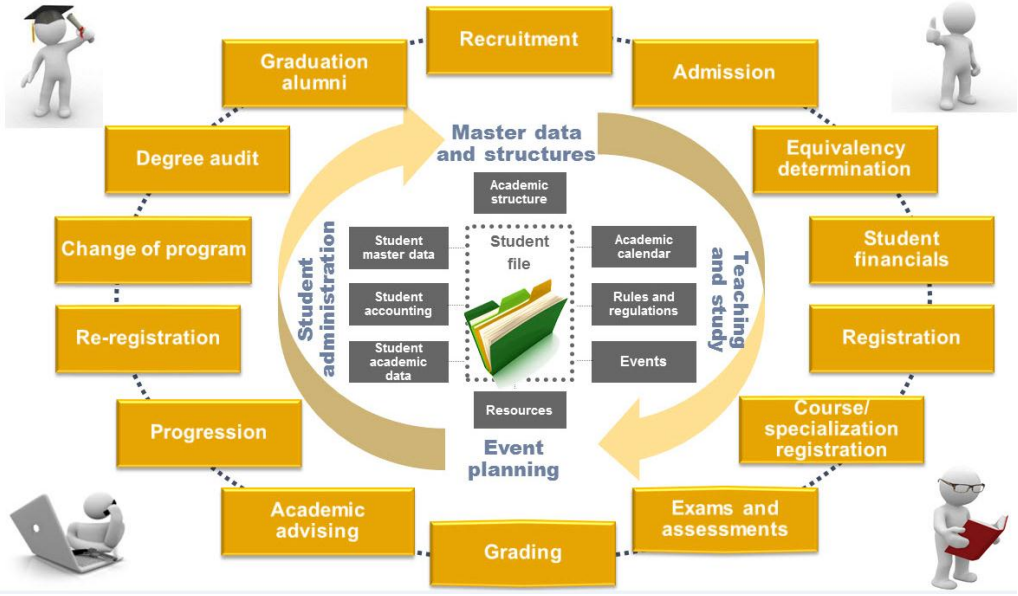
The Opportunity

The window of opportunity to lead your way

Real-time Operational Intelligence is the new frontier



Student & Learning Analytics Use Cases



- Basis for setup of proof of concept
- Use cases are result of first **brainstorm**
- We took the **SAP Student Lifecycle** processes as the first basis
- Use cases are divided in different **focus areas**:
  - Operational reports
  - Management reports
  - ‘Predictive’ analytical reports

Student & Learning analytics Use Cases (1/5)

- **Recruitment & Admission**
  - Predict which prospects (enquiries) are likely to become applicants
  - Predict which applicants are likely to graduate. Build a predictive model based upon students success trends.
    - **Focus area**: operational predictive analytics
  - Capture Social media (Facebook, Linkedin, etc) data analyse where applicants are most active and where a CRM campaign could be most effective
    - **Focus area**: operational predictive analytics
  - Applicant ranking after Admission application audit. Include extra student data/private/social media data etc. Optimise student retention/graduation.
    - **Focus area**: operational predictive analytics

Student & Learning analytics Use Cases (2/5)

- **Recruitment & Admission**
  - Real-time admission dashboard; Number of applicants, # rejections, # withdrawals, # approvals. Incl. historical view, ‘The pipeline report”: where were we last year on this day?
  - **Focus area**: operational & management analytics.
  - Sentiment analysis to determine what applicants and students like, not like on campus (life)
    - **Focus area**: operational & management analytics.

Student Financials

- Analytics on fee collection data; to determine early late payers also based on historical data
  - **Focus area**: operational predictive reports

Student & Learning analytics Use Cases (3/5)

- **Equivalency determination**
  - Report on the equivalency determination agreements and how they are used (in detail with the courses used) and how many times applied, etc etc
    - **Focus area**: operational & management analytics.

- **Event planning/Scheduling & Course registration**
  - Use predictive analytics during course registrations to help students select the most applicable (course suggestion) course based parameters eg. program registration, specialization registration, remaining capacity, predicted grade, academic standing, etc.
  - Use scheduling information to support facility management & real-estate planning
    - **Focus area**: operational predictive reports

Student & Learning analytics Use Cases (4/5)

- **Exams & Grading (& attendance tracking)**
  - Analytical reports showing trends of courses and their grades.
  - Analytics of what is the relation between actual attendance and the grade outcome.
    - **Focus area:** operational predictive reports

- **Academic Advising/Student Retention**
  - Use predictive analytics during academic advising as an early alert system based on parameters eg. Academic standing, number of student logons in key systems like student portal, LMS (Blackboard), Course evaluation, etc.
    - **Focus area**: operational predictive reports

Student & Learning analytics Use Cases (5/5)

- **Progression & degree audit**
- Use predictive analytics during registration/academic advising to monitor and alert the graduation time (nr. of years)
  - **Focus area**: operational predictive reports

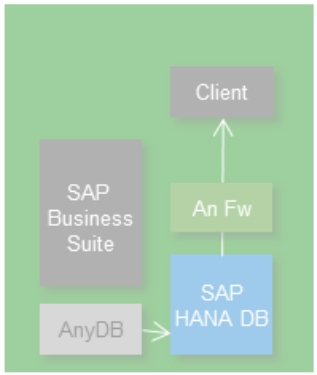
- **Graduation**
- Relation to degree audit/course registration. Notify student that they are close to graduation should book courses that will help them graduate soon(sooner).
  - **Focus area**: operational predictive reports

Student & Learning analytics Main thread in use cases

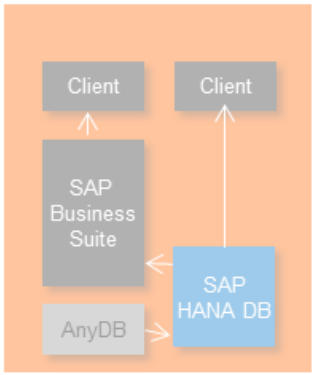
- **Informed decision making**
- Direct management information
- **Early Alert reporting** (e.g. Academic advising, Student retention)
- Applicant & Student **success prediction**
- **Student retention prediction**
- Direct information to optimize processes/student success
- **Identify & Support specific student groups**

SAP HANA scenario's

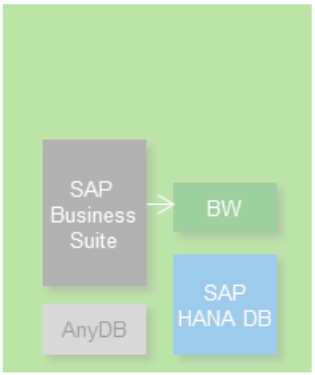
SAP HANA Analytics (via Analytics Foundation)



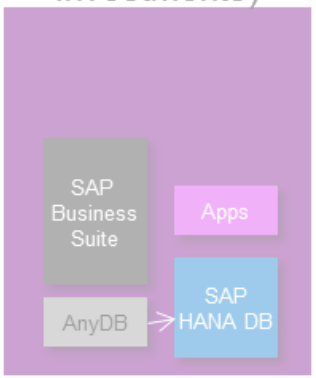
SAP HANA Accelerators



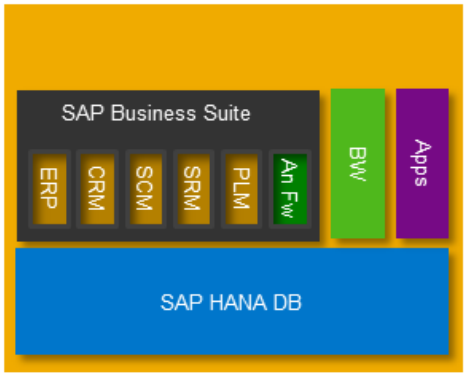
BW on SAP HANA



Apps on SAP HANA (Next Generation & Strategic Investments)



Business Suite/SLcM on SAP HANA



Side-by-side scenarios

Integrated scenario

More Insight: Exploring data loaded from Business Suite on any level of detail

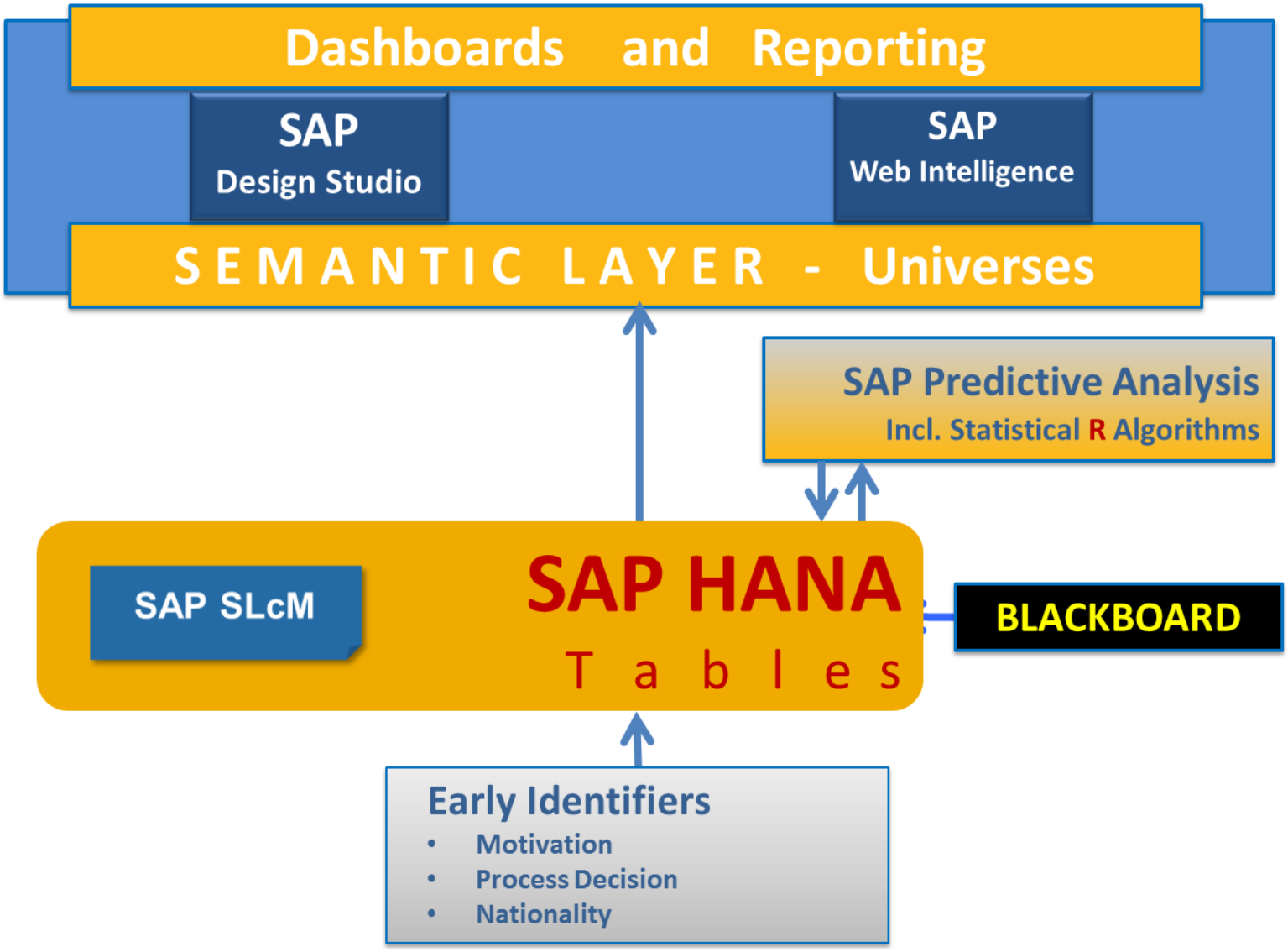
In seconds: Accelerating existing transactions of the Business Suite

Supercharged BW : Fasten up your BW without disruption

Innovation: Functional applications natively built on SAP HANA, with & without Business Suite integration

All in One – Ultimate: Business Suite/ SLcM/third party data on HANA to deliver lighting speed (predictive) operational analytics

SAP HANA (Live) & consumption layer



The proof-of-concept

SAP HANA Student Learning analytics POC: Goals

Co-Development

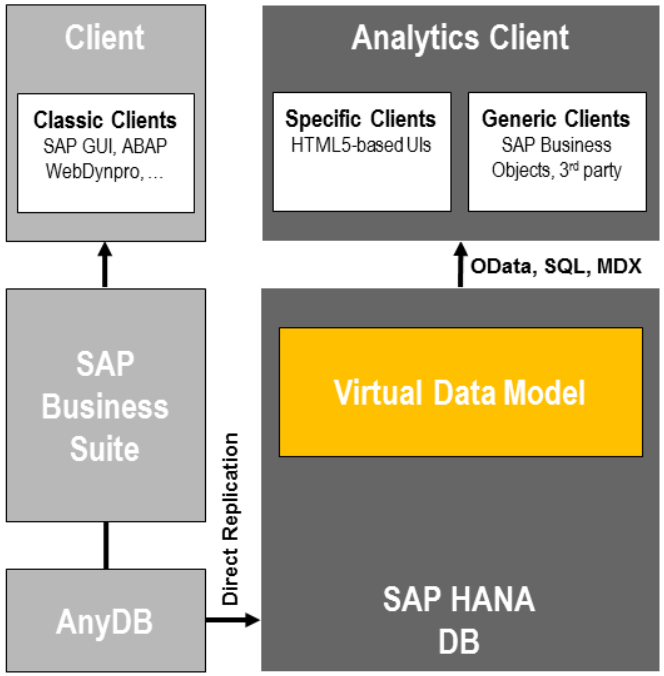
- **Innovation** area
- Build a proof-of-concept which delivers **operational and predictive reporting** on student & learning data
- Create student & learning **data model**
- Build **consumption reports** (UI)
- SAP HANA for (Higher) Education POC: **Test and Validate**

Why HANA? Why Operational (predictive) reporting? Why student & learning data?

- SAP Student Lifecycle Management has only **few standard operational reports**
- **Student & learning data** is a university's core data
- Get the most out of **SOH** (SLcM) and leverage i**n-memory** reporting
- Support customers with an existing SAP HANA **roadmap**
- Improve reporting **UI experiences** with new UI's

SAP HANA Student Learning analytics POC: Definition

The "SAP HANA Student Learning analytics – POC" outlines an opportunity to develop a new solution for use in the SAP (Higher) Education market.



Focus:

- The focus of the concept is on **(operational) reporting, academic advising and student retention**.

The following elements are build so far

- **HANA Virtual data model** based on:
  - SIS data (SAP Student Lifecycle Management)
  - LMS data (Blackboard)
- 4 **'consumption' reports** based on Business Objects reporting tools:
  - 2 operational descriptive reports via BO Web Intelligence
  - 1 operational descriptive report via BO Dashboard Design
  - 1 predictive report via 'R'
- Documentation
- Final report

SAP HANA Student Learning analytics POC: Main project steps

KU LEUVEN

UNIVERSITEIT VAN AMSTERDAM

SAP

itelligence NTT DATA Business Solutions

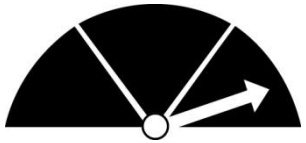
Focus:

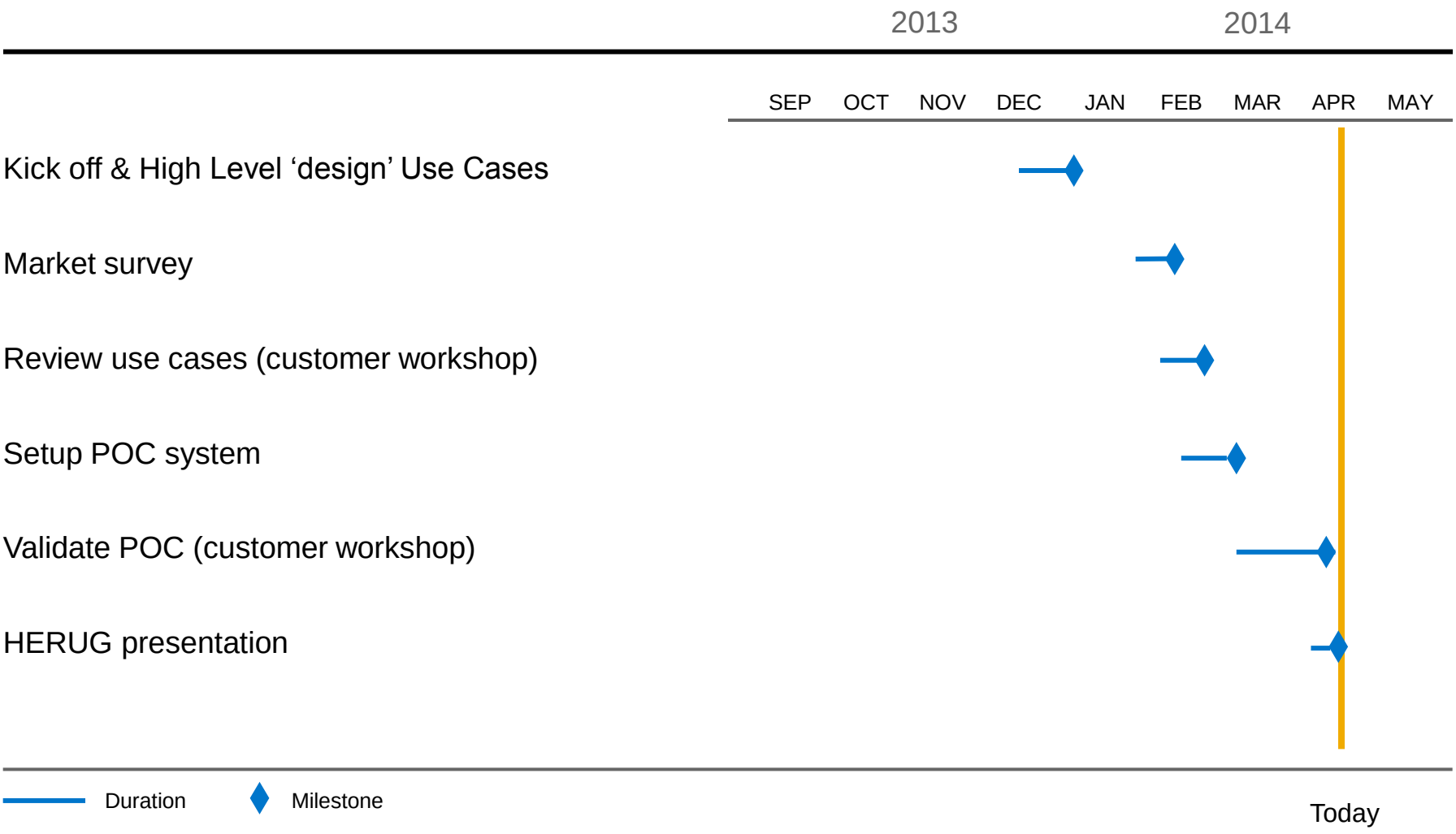
- SAP SLcM as primary student data source (e.g. admission, course registration, grades, etc)
- Learning LMS data (e.g. activity data around LMS activities, e-learnings, etc).
- Optional: CRM data (e.g. student prospect data, etc), scheduling data, etc.

Project steps:

- **Market survey**: Desk research on student analytics in Higher Education. How can learning analytics support informed decision making in key areas like recruitment, admission, retention, etc.
- **Customer workshop**: Roll-in workshop with 2 customers that have an existing HANA roadmap
- Based upon the concrete outcomes from 1 and 2 ➔ Setup, design & develop a **proof-of-concept**.
- Transform proof-of-concept into a **product & service**

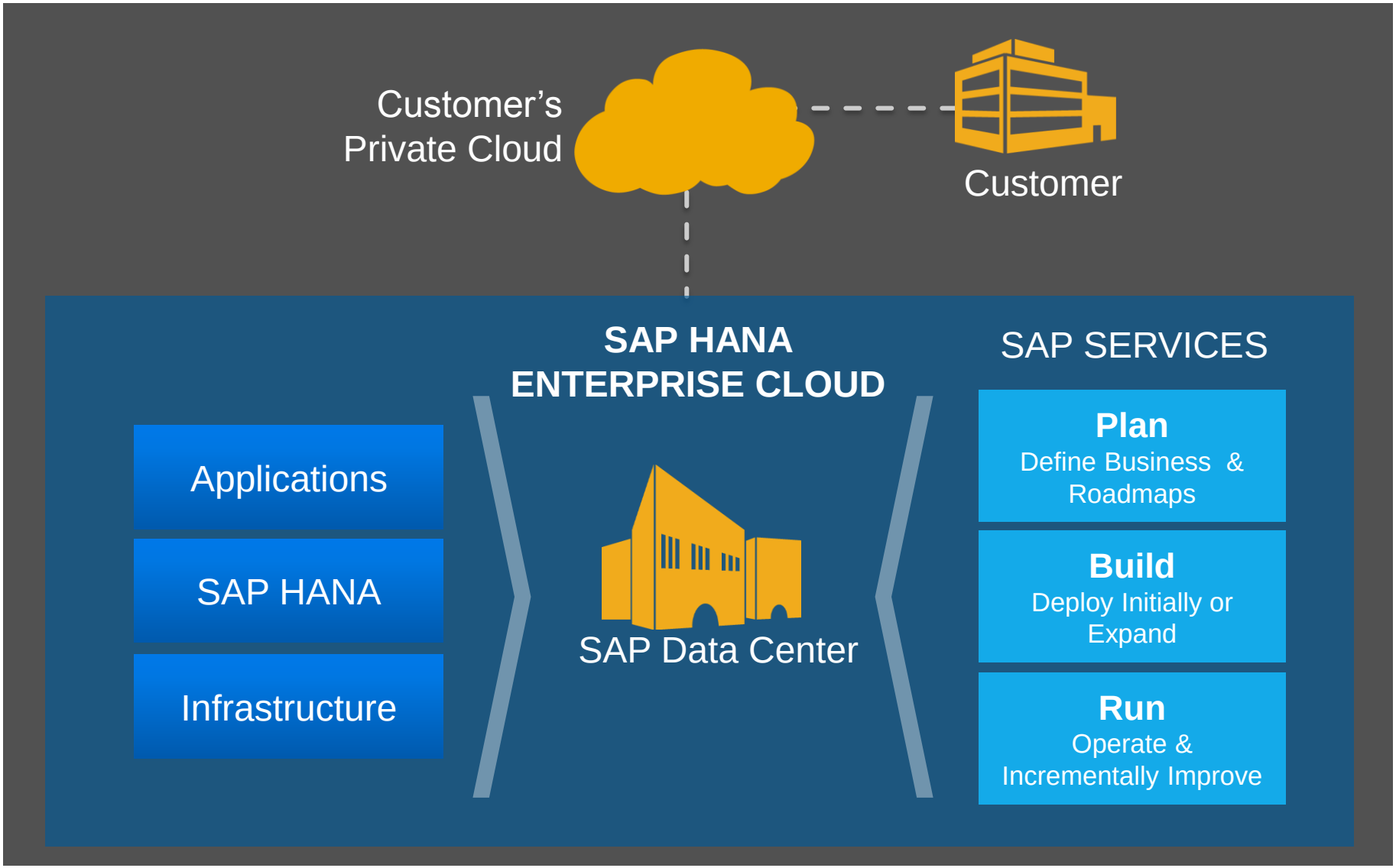
SAP HANA Student Learning analytics POC: Planning





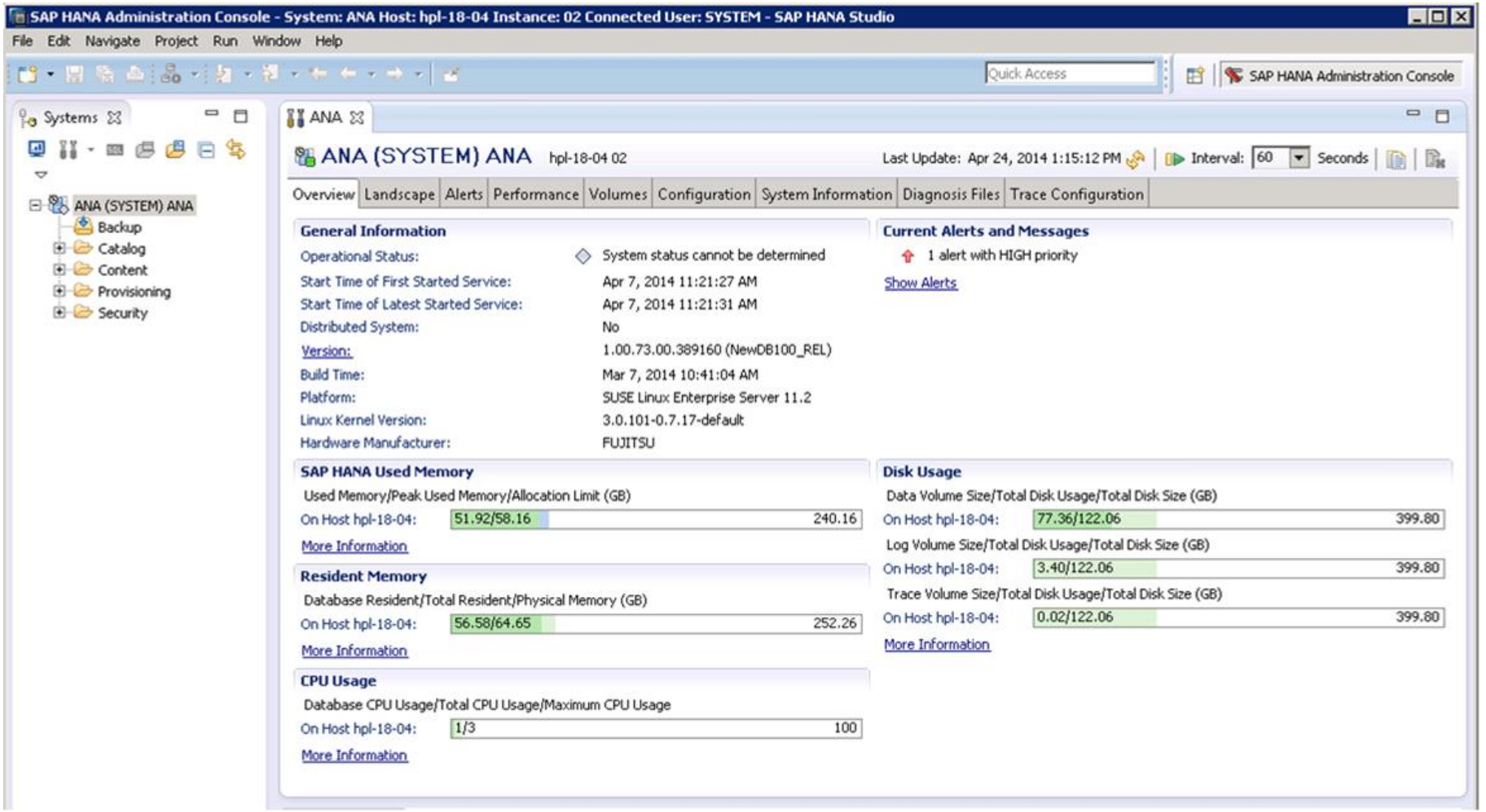
The DETAILS on the proof-of-concept

SAP HANA System Details: SAP HANA Enterprise Cloud (HEC)



SAP HANA System Details

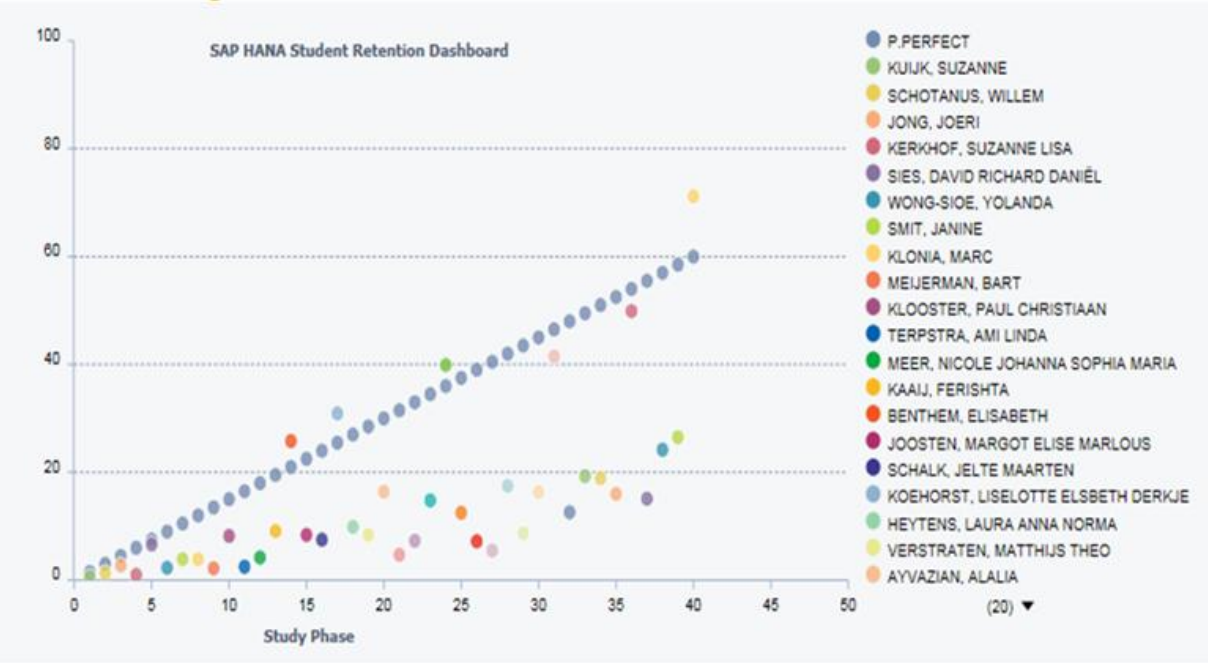
The HANA-Server has 256 Gig RAM and 4 processors (Xeon(R) CPU E5-2670 0 @ 2.60GHz) with respectively 8 cores = 32 physical CPU cores. Central Instance and database are installed on the same server.



SAP HANA Student Retention Dashboard: Predictive Analysis

Predictive Analysis for Academic Advisors

Student Retention

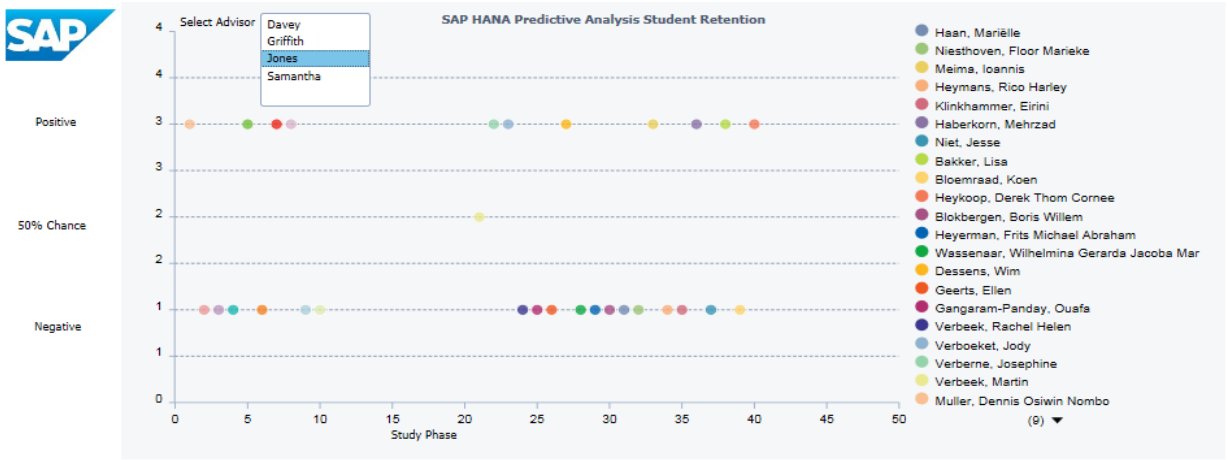


- **Predictive Analytics** for Academic Advisors
- **Academic Advisors** need a list of students which are categorized as “presumable **non-retention**”.
- Used to initiate **dialog** with the student about his study **progression**

SAP HANA Student Retention Dashboard: Predictive Analysis

Predictive Analysis for Academic Advisors

Student Retention



Students with red flags

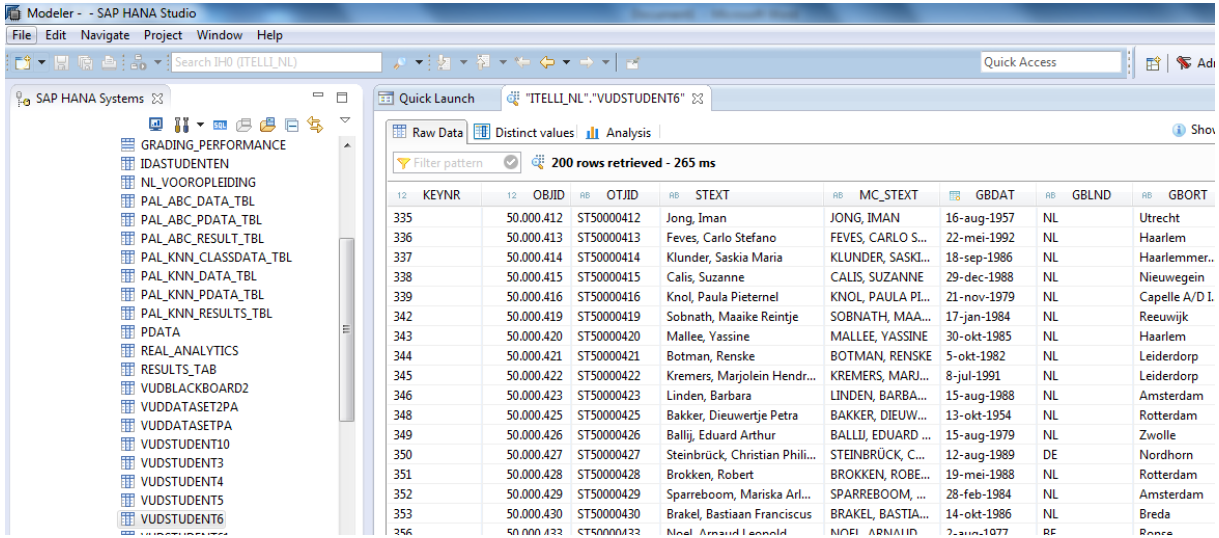
Advisor	Student	Type	Birthdate	Place	Gender	CR	Week	Motivation Factor	Study Selection Process
Jones	Megens, Leona Enayat	1	11/28/76	Hoorn	2	5.2	2	3	1
	Nieuwenhof, Zoé Rose	1	10/17/88	Heemstede	2	7.8	3	1	2
	Heyenk, Marieke	1	9/7/83	Boekarest	2	10.4	4	2	1
	Wallart, Jesse	1	12/8/86	Amsterdam	1	15.6	6	2	1
	Waaijer, Daniella	1	1/24/68	Woerden	2	23.4	9	1	1
	Mehciz, Franziska	1	8/30/84	Amsterdam	2	27	10	2	4

- **Predictive Analytics** for Academic Advisors
- **Academic Advisors** need a list of students which are categorized as “presumable **non-retention**”.
- Used to initiate **dialog** with the student about his study **progression**

SAP HANA Student Learning analytics POC: Data flow (for dummies)

HANA STUDIO TABLES

SLcM Data



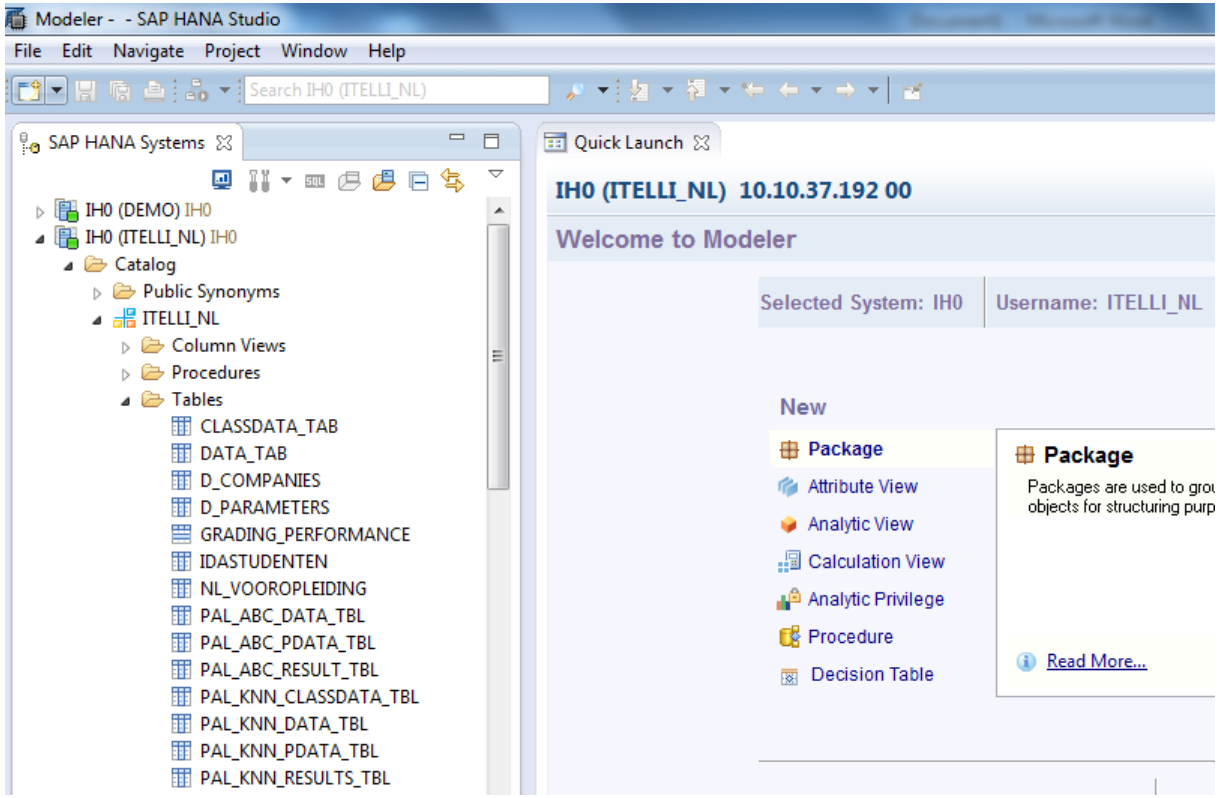
KEYNR	OBJID	OTJID	STEXT	MC_STEXT	GBDAT	GBLND	GBORT
335	50.000.412	ST50000412	Jong, Iman	JONG, IMAN	16-aug-1957	NL	Utrecht
336	50.000.413	ST50000413	Feves, Carlo Stefano	FEVES, CARLO S...	22-mei-1992	NL	Haarlem
337	50.000.414	ST50000414	Klunder, Saskia Maria	KLUNDER, SASKI...	18-sep-1986	NL	Haarlemmer..
338	50.000.415	ST50000415	Calis, Suzanne	CALIS, SUZANNE	29-dec-1988	NL	Nieuwegein
339	50.000.416	ST50000416	Knol, Paula Pieternel	KNOL, PAULA PI...	21-nov-1979	NL	Capelle A/D I.
342	50.000.419	ST50000419	Sobnath, Maaike Reintje	SOBNATH, MAA...	17-jan-1984	NL	Reeuwijk
343	50.000.420	ST50000420	Mallee, Yassine	MALLEE, YASSINE	30-okt-1985	NL	Haarlem
344	50.000.421	ST50000421	Botman, Renske	BOTMAN, RENSKE	5-okt-1982	NL	Leiderdorp
345	50.000.422	ST50000422	Kremers, Marjolein Hendr...	KREMERS, MARJ...	8-jul-1991	NL	Leiderdorp
346	50.000.423	ST50000423	Linden, Barbara	LINDEN, BARBA...	15-aug-1988	NL	Amsterdam
348	50.000.425	ST50000425	Bakker, Dieuwertje Petra	BAKKER, DIEUW...	13-okt-1954	NL	Rotterdam
349	50.000.426	ST50000426	Ballij, Eduard Arthur	BALLIJ, EDUARD ...	15-aug-1979	NL	Zwolle
350	50.000.427	ST50000427	Steinbrück, Christian Phili...	STEINBRÜCK, C...	12-aug-1989	DE	Nordhorn
351	50.000.428	ST50000428	Brokken, Robert	BROKKEN, ROBE...	19-mei-1988	NL	Rotterdam
352	50.000.429	ST50000429	Sparreboom, Mariska Arl...	SPARREBOOM, ...	28-feb-1984	NL	Amsterdam
353	50.000.430	ST50000430	Brakel, Bastiaan Franciscus	BRAKEL, BASTIA...	14-okt-1986	NL	Breda

- Student Lifecycle Management (**SLcM**) data fully integrated in **SAP HANA tables**.
- **Example** of an SLcM data table in HANA with **HRP1702** attributes
- Import **external** data via **dataservices** (eg. “BlackBoard”)

SAP HANA Student Learning analytics POC: Data flow (for dummies)

HANA STUDIO PREDICTIVE TABLES

Student Retention

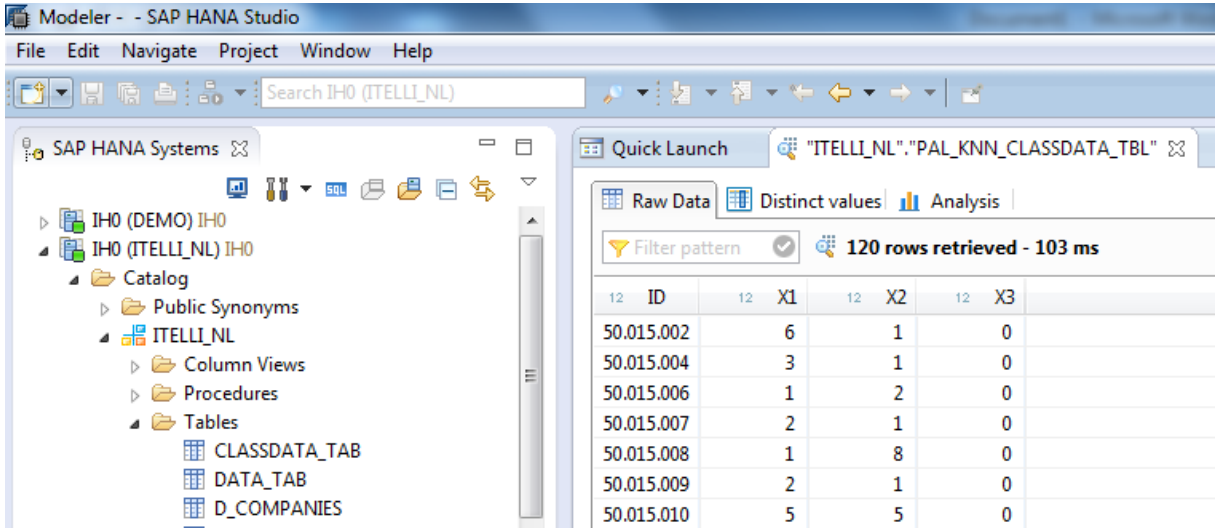


- **Predictive modelling**
  - **Data table:** (un)Successfully graduated students and their past results
  - **Class data table:** Students we want to evaluate
  - **Results table:** Output after running the KNN algorithm: which student will drop out, who will succeed

SAP HANA Student Learning analytics POC: Data flow (for dummies)

HANA STUDIO PREDICTIVE TABLES

Class data

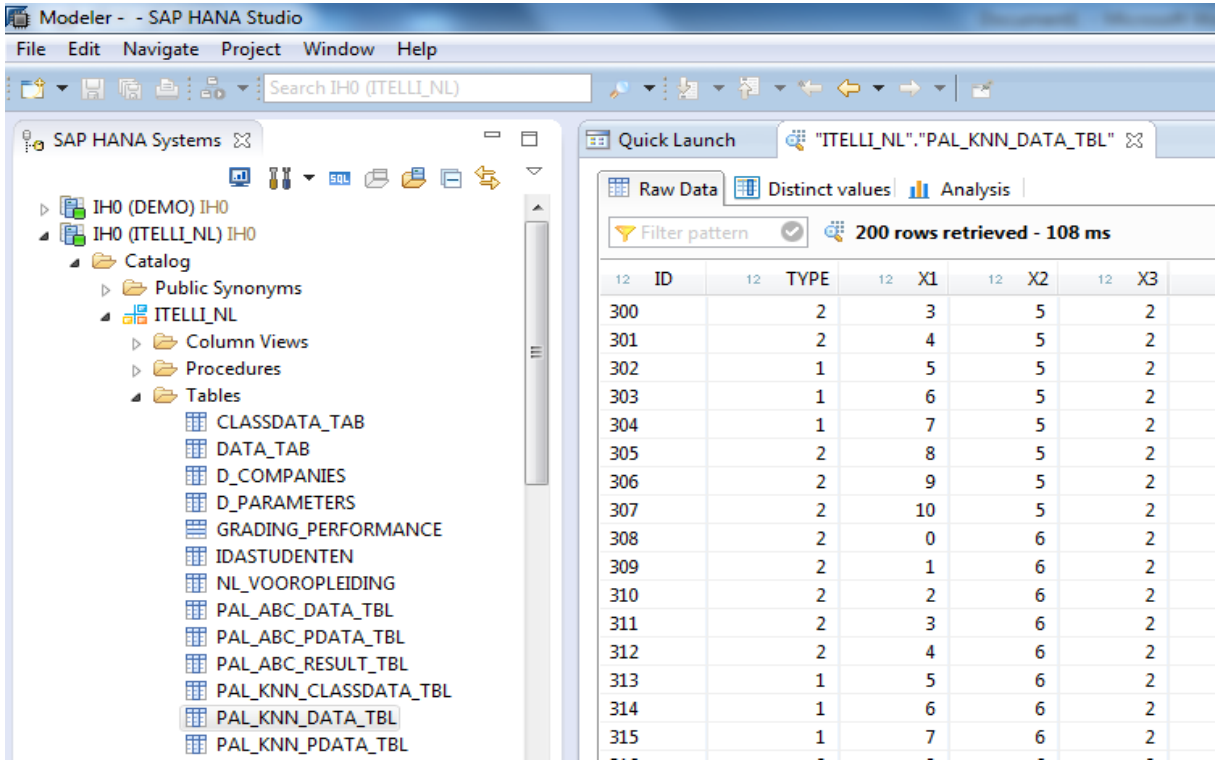


- **Class data table**
  - **X1**: student motivation factor
  - **X2**: process study selection (well considered decision on study selection)
  - **X3**: Health condition from student (disability)
- **Data input** via CRM, specific questions during admission, student survey, app, etc.
- Generated data for POC

SAP HANA Student Learning analytics POC: Data flow (for dummies)

HANA STUDIO PREDICTIVE TABLES

Student data table



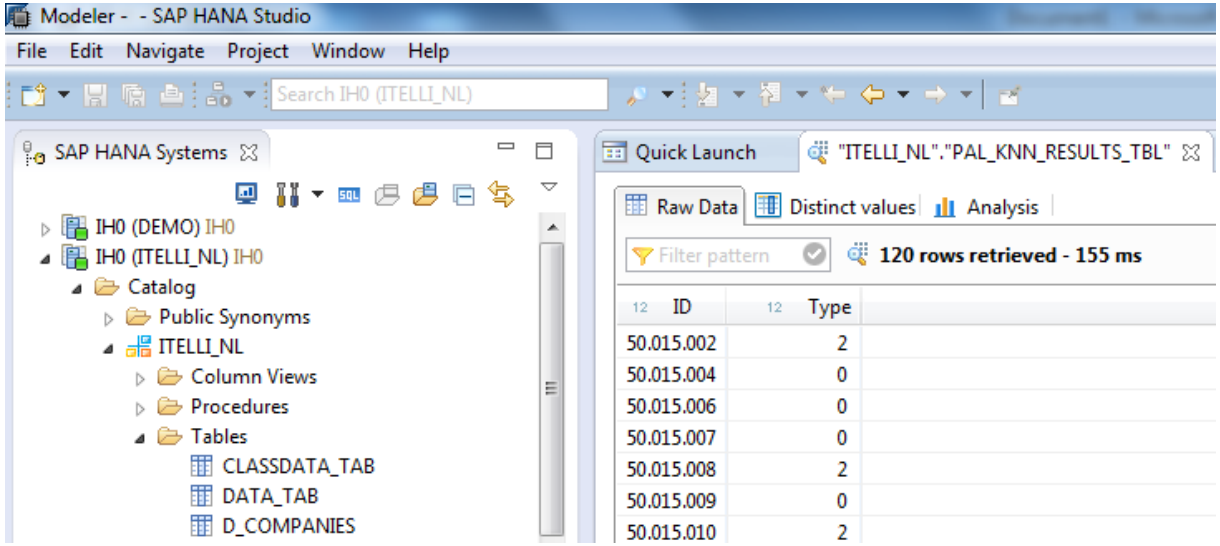
ID	TYPE	X1	X2	X3
300	2	3	5	2
301	2	4	5	2
302	1	5	5	2
303	1	6	5	2
304	1	7	5	2
305	2	8	5	2
306	2	9	5	2
307	2	10	5	2
308	2	0	6	2
309	2	1	6	2
310	2	2	6	2
311	2	3	6	2
312	2	4	6	2
313	1	5	6	2
314	1	6	6	2
315	1	7	6	2

- **Student data set::**
  List of students (un-) succesfully graduated with all factors x1,2,3
  - **X1**: student motivation
  - **X2**: study selection
  - **X3**: disability
- **Reference** data set

SAP HANA Student Learning analytics POC: Data flow (for dummies)

HANA STUDIO PREDICTIVE TABLES

Results table



- **Results from KNN run:**
  List of students (un-) succesfully graduated with all factors x1,2,3
  - **Type 2:** will succeed (prediction)
  - **Type 0:** will not succeed (prediction)

SAP HANA Student Learning analytics POC: Data flow (for dummies)

HANA STUDIO PREDICTIVE ANALYTICS FUNCTIONS

KNN function

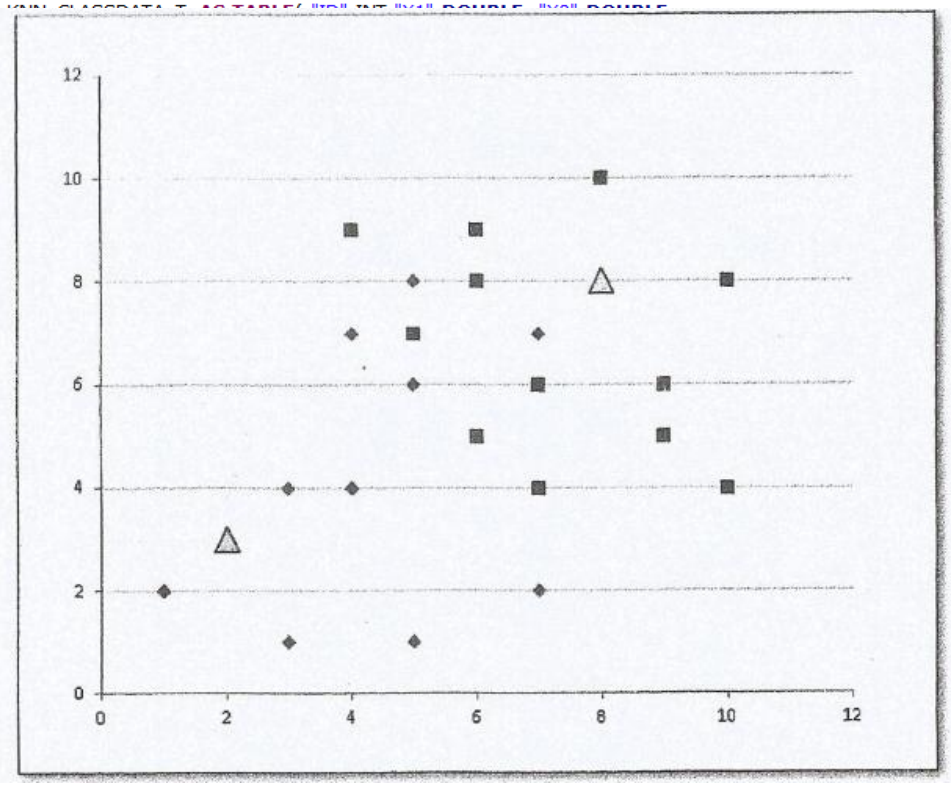
```
SET SCHEMA ITELLI_NL;
DROP TYPE PAL_KNN_DATA_T;
CREATE TYPE PAL_KNN_DATA_T AS TABLE( "ID" INT,"TYPE" INT,"X1" DOUBLE,
"X2" DOUBLE, "X3" DOUBLE);
DROP TYPE PAL_KNN_CLASSDATA_T;
CREATE TYPE PAL
"X3" DOUBLE );
DROP TYPE PAL_K
CREATE TYPE PAL

DROP TYPE PAL_C
CREATE TYPE PAL
"doubleArgs" DOUE
DROP table PAL_K
CREATE column t
"DIRECTION" VARC
insert into PAL_KN
insert into PAL_KN
insert into PAL_KN
insert into PAL_KN

GRANT SELECT O
call SYSTEM.afl_w
call SYSTEM.afl_w
PAL_KNN_PDATA_T

DROP TABLE #PAL
CREATE LOCAL TE
VARCHAR(100),
"intArgs" INT, "doul
INSERT INTO #PA
INSERT INTO #PA
INSERT INTO #PA
INSERT INTO #PA

DROP TABLE PAL_
CREATE COLUMN
CALL _SYS_AFL.PA
"#PAL_CONTROL_T
SELECT * FROM P
```



- **KNN:** Predictive Analytics functions in use to calculate the relative weight of the student-retention parameters
- **KNN:** is a machine learning algoritm used for classification
  - the **input** consists of the *k* closest training examples
  - the **output** is a class membership
- **SAP HANA** Predictive analysis **library**

SAP HANA - Operational Reporting Course Registration Details

- **Operational reporting !**
- **Web intelligence** report
- **BusinessObjects**
- **Input controls**:
  - Faculty
  - Academic term
  - Course
  - Student

Lessons Learned

Lessons Learned … so far

Team

- Bundling expertise: educational, technical, statistical, pedagogical, …

Analytics

- What is Student Learning analytics?
- The data used and the questions asked define a certain Predictive Model
- HANA Studio provides big advantages in terms of agility and flexibility to define data model and predictive models

Data

- Which data can be seen as relevant learning data?
- Quality of the data! Great analysis on wrong data …
- Privacy? Legal restrictions?

5 key points to take home

- SAP HANA allows for **faster and smarter (reporting)** solutions
- With HANA Live you can build data models that provide **real-time insight** into your business
- Customer can perform real-time reporting on **(big) student & learning data**
- The POC already proven the **power of the SOH concept** for SLcM in relation to **(predictive) operational reporting**

Appendix

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April 30, 2014 | Newsbyte | by SAP News

SAP Announces Plans for First Big Data Innovation Center and Innovation Lab With Universities

WALLDORF — SAP AG today announced the planned launch of its first Big Data innovation center in a cooperation between the SAP University Alliances program and the University Competence Center (UCC) location at Otto-von-Guericke University in Magdeburg, Germany. As part of this relationship, the company also announced the anticipated opening of the first SAP University Alliances Innovation Lab with the Institute of Enterprise Systems (InES) at the University of Mannheim. Additional Big Data innovation centers at UCC locations and innovation labs at universities worldwide are planned.

"SAP already offers the SAP HANA platform for teaching purposes at universities," said Dr. Bernd Welz, executive vice president, global head of Solution and Knowledge Packaging SAP. "With Big Data innovation centers at UCC locations, the company is planning to enable academics worldwide to leverage SAP HANA to re-invent business processes based on new Big Data applications. The lab would also be used for Big Data-driven research across a wide range of applications such as genetics, geology or physics."

The Big Data innovation center will be hosted at the Otto-von-Guericke University, which has a long-term relationship and hosting experience with SAP. The center in Magdeburg is intended to closely cooperate as an interdisciplinary research hub with the new innovation lab at the University of Mannheim, a top university in Europe. The SAP University Alliances Innovation Lab at the InES is planned to offer a platform for scientists, practitioners and startups to explore, design and evaluate data-driven process excellence in enterprises and business networks in areas such as smart logistics, Internet of Things, process intelligence, predictive maintenance and others. It also aims to help identify and verify new use cases based on a solid Big Data technology platform and can be utilized by data scientists, mathematicians or economists for a variety of industry sectors, including automotive, manufacturing, banking, utilities, retail and public sector.

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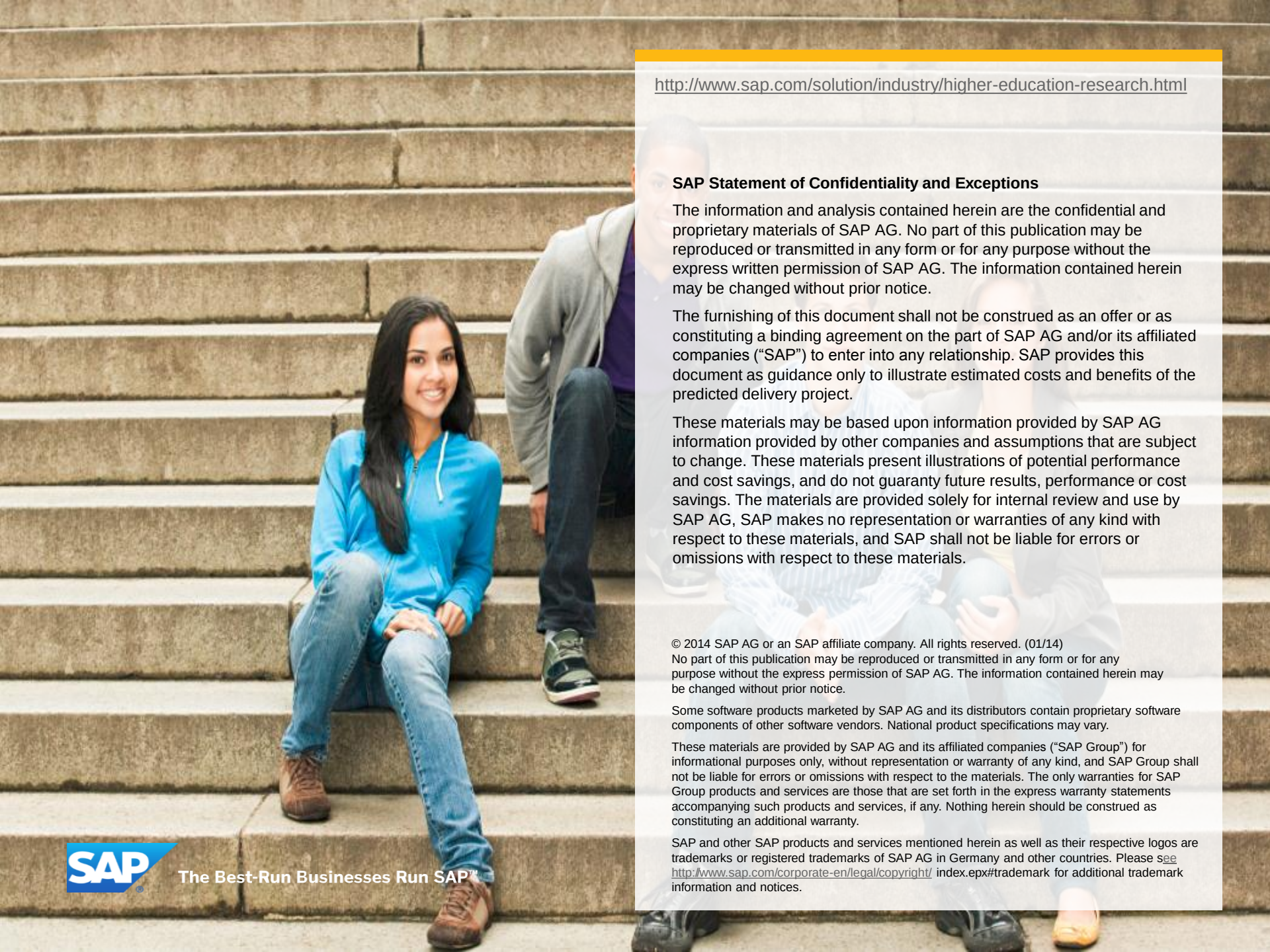

http://www.sap.com/solution/industry/higher-education-research.html

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