Learning Analytics
in Enterprise Performance Management
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Context

Analytics is a term used for getting structured information from a set of data to enhance the decision capability of process engineers and managers. Analytics as a science in the learning paradigm is less understood and equally less applied for successful interpretation of results.

In traditional business management, data analytics would be a sub-set of three layers:

1. Business skills and domain knowledge
2. Capability to understand & explore data, and
3. A platform that applies algorithms to business skills and data for providing meaningful information.

So, analytics is not complete without these three layers. These three layers extended to Learning Analytics (LA) would be:

1. Learning and performance functional consultants with deep knowledge of the industry domain,
2. Statistical process that would analyse information on performance and learning data
3. IT system to integrate data systems and provide meaningful reports

This is represented in the Venn diagram (Figure 1). Thus, learning analytics is not just an IT platform as generally perceived, rather, learning analytics aims to develop an ecosystem that provides the best of breed in all the three layers.

Figure 1: Learning Analytics Venn diagram
Learning analytics is an emerging field in which sophisticated analytic tools are used to improve learning and education. It draws from, and is closely tied to, a series of other fields of study including business intelligence, web analytics, academic analytics, educational data mining, and action analytics.

Addressing next generation learning challenges is the goal of this emerging field, as it has the ability to scale real-time use of learning analytics by learners, instructors, and training advisors to improve the success rates of employees as well as that of an organisation. Thus, the focus is on the selection, capture, and processing of data that will be helpful for learners and instructors at the course or individual level. Moreover, learning analytics is focused on building systems that are able to adjust content, levels of support and other personalised services by capturing, reporting, processing and acting on data on an ongoing basis in a way that minimises the time delay between the capture and use of data. Thus, in contrast to current evaluation processes that use results from the successful completion of a set of courses to inform improvements in the next, learning analytics seeks to combine historical and current user data to predict the kinds of services that users may find useful. In this white paper, we focus on how TIS is evolving Learning Analytics in Enterprise Performance Management, the framework and micro-solutions for ease of gradual evolution. The paper also talks about the challenges and benefits that this service brings to the industry.

Enterprise Performance Management (EPM)

As per Gartner, Enterprise Performance Management (EPM) is the process of monitoring performance across the enterprise with the goal of improving business performance. An EPM system integrates and analyses data from many sources (including, but not limited to) e-commerce systems, front-office & back-office applications, data warehouses and external data sources. Advanced EPM systems can support many performance methodologies such as the balanced scorecard.

Enterprises have in the last two decades made significant investment in EPM systems like planning, budgeting & forecasting, profitability modelling analysis, regulatory management, and sales performance management. The success of these implementations has been limited, as there has been very little integration with the core of EPM, i.e., human resource learning and development. Also, EPM has largely been focused on IT automation with less focus on how the core asset ‘Human attribute’ has been evolving. It’s only recently that enterprises have started realising the potential of integrated performance reporting and score carding in the overall EPM schema. TIS’ Learning Analytics Framework (LAF) aims to close the gap...
between learning analytics and EPM by developing a scorecard-based approach to map the current data systems (Figure 2). This will help organisations to monitor, measure & manage performance at the tactical & strategic level and align themselves to a dynamic learning environment coupled with instructional strategy.

Figure 2: Learning Analytics in EPM framework

Levels of Enterprise Learning Analytics

Learning analytics covers a wide range of analytics, which we define as macro, meso and micro level in any enterprise.

Macro Level Analytics
Macro level analytics is aimed at intra and inter-enterprise level performance of the employees. This level aims to understand how human learning and performance are impacting the strategic outcome of an organisation and provides input to the CLO to align learning strategy with the strategic business roadmap. For instance, the CLO along with the CMO and Head of Sales could develop a learning solution that will optimally realign sales field activities to marketing initiatives.

Meso Level Analytics
Meso level analytics operates at functional levels of any enterprise - to the extent that different functions like sales, finance and SCM share common business processes already benefiting from BI (Business Intelligence). Inculcating learning intelligence and people performance would further benefit to integrate the business process to the core human assets. Enterprise can use appropriate tools to integrate functional level human data silos in enterprise warehouses, optimise workflows, generate dashboards, mine unstructured data, better predict ‘employee churn impacting customer churn’ and future markets, among others.
**Micro Level Analytics**

Micro level analytics supports the tracking and interpretation of process-level data for individual learners (and by extension, groups). This data is of primary interest to learners themselves, and those responsible for their success, since it can provide the finest level of detail, ideally as rapidly as possible. This data is correspondingly the most personal, since (depending on platforms) it can disclose online activity click-by-click, physical activity such as data on Yammer, serious learning games, simulations, incident reports, machine logs, transactional data, etc. Data analysts at TIS are adapting techniques from fields including serious gaming, automated marking, content data mining, computer-supported collaborative learning, recommender systems, intelligent tutoring /adaptive systems, hypermedia, information visualisation, computational linguistics & argumentation, and social network analysis. Traditionally, it is at this level that analytics can provide predictive correction of learning roadmap and optimal fitment of dynamic instructional strategy.

As we see from Figure 3, learning analytics needs to evolve into an ecosystem that integrates all the layers for mutual enrichment. The aggregation of thousands of learners’ interaction histories across cohorts, temporal periods, functions, regions and countries creates meso + macro level analysis with an unprecedented level of fine-grained process data. This, in turn, leads to the creation of large big datasets and makes it possible to identify and validate patterns that are more robust for business intelligence. In other words, the breadth and depth at the macro & meso levels add power to micro analytics (Scenario: In the chemical industry, the main focus is on health and safety. Forums like cefic (The European Chemical Industry Council) would benefit if all its member companies can...
TIS’ learning analytics maturity model helps organisations gauge their current maturity, understand alignment to their overall strategy in learning and allows them to aim for a maturity level in a planned and structured manner.

Business Intelligence is the first layer of analytics which provides correlation between key KPIs and high level trend analysis.

For example, in this stage, organisations can have a better view on the employee profile and how it is impacting their learning behaviour.

register that data on use of safety online simulated trainings to improve safety and performance. These data would form the base-line for global chemical companies and can be analysed though BIG DATA to reduce and predict human errors thereby leading to more safe production.)

**TIS’ Learning Analytics Maturity Model (LAMM)**

TIS has developed LAMM (Learning Analytics Maturity Model) to provide stage-wise guidance and transformation of enterprise human performance and learning management systems so that they can leverage on the advantages of macro-meso-micro levels’ integration. This paper will discuss the details of each level in describing the stage, implementation of solution, business & IT landscape and business benefits. Holistically, LAMM is the 3rd generation of learning analytics.

![Figure 4: LAMM – The 3rd Generation of Learning Analytics](image)

**Generation Maturity**

Organisations can be classified under three maturity levels based on where they stand in learning analytics application:

- **Generation 1**: 90% of the organisations use LMS and desperate data to measure L&D
- **Generation 2**: 5-9% of the organisations would have developed systems to correlate through manual interventions and analysis the impact of learning on business
- **Generation 3**: Organisations those have developed IT platform integrating relevant information systems (Like LMS, CRM, ERPs) to provide predictive and prescriptive personal learning

LAMM has five stages that helps an organisation to map their current
learning analysis process and move up the maturity curve.

**Descriptive**

The first kind of analytics that most organisations encounter is the dashboard that's provided by the learning function. The L&D department captures data through excel sheets, learning management systems or legacy level enterprise performance management systems. This is essentially the impact of business intelligence products on learning platforms. In fact, there exist several LMS platforms that describe their reporting system as learning analytics.

This level is limited to data measured with metadata restricted to course and training management and does not provide any relationship to business impact. Almost 99% of organisations are limited to this level and are bound by their LMS. Scientifically, however, we cannot call this stage ‘analytics’, as it misses statistical data analysis and correlation to respective business domain.

TIS’ LMS dashboard provides similar dashboard and reports for learning management. This is generation 1 in learning analytics.

**Diagnostic**

There are several organisations who have taken a step further and included additional information visualisation on products that assist in making sense of complex data, or enterprise-level analytics architectures. This stage transforms the organisation from micro to meso level and provides a high-level relationship between learning and performance KPIs. This stage includes the second layer of analytics which is business domain interjection in managing and measuring the learning metrics. This is also the stage where organisations converge the LMS with CMS (Content Management System) and use new frameworks like TIN CAN where more data pertaining to an employee’s formal and informal learning behaviour can be collected.

This level is also limited to data collection, but what is different from the descriptive level is that the data is now measured beyond the LMS, from systems such as social learning, performance at job, HRMS and log books. The BI platform provides visualisation and leaves it largely for the user to make optimal use of the visual interactive analytics provided by the platform.

TIS implements business intelligence using the Tableau software, thereby
integrating business functions (such as customer service performance) with training (e.g. customer services training) and offers a much better view of training diagnostics as well as batch performance in different KPIs. The below dashboard (Figure 5) shows how training in a customer service environment is measured across – from the time of learning to real performance in the field, thereby providing rich data to instructors in contact centres for identifying the type and frequency of refresher training.

![Sample Dashboard](image)

Figure 5: Sample dashboard – Learning performance linked to field performance in a contact centre.

Discovery

This second generation of learning analytics is based on deriving correlations between data. During this stage, data science and its metrologies are used. This stage moves from data reporting to data correlation analysis; for example, Flood Mapping of a city to understand Fraud Detection probability across a segment of people. This is called discovery, as it provides the organisation with information that helps in making functional level strategic discussion. An example could be mapping the various data on attrition and discovering the attributes that have an impact with probability of occurrence. The second layer of analytics, which is statistical data analysis is applied to discover the data pattern and provide enhanced insights.

Predictive

One of the more advanced uses of analytics that generates huge interest is the possibility that from the pattern of the employee learning and performance statistical data (e.g. demographic, learning profile, human
In the predictive stage, the organisation’s analytical platform develops the capability to predict future optimal solutions to problems.

Many universities use this model to best fit courses as per the IQ and EQ of their students.

Errors) and dynamic data (e.g. pattern of online logins, pages visited, quantity of discussion posts) one can classify the trajectory that they are on (e.g. ‘at risk’, ‘high achiever’, ‘social learner’), and hence make more timely interventions (e.g. offer extra social and academic support, present more challenging tasks).

Presently, one of the most reliable predictors of a learner’s performance continues to be his/her accomplishment that is assessed and measured by the LMS. The design of more complex data-driven predictive models must clearly improve this, but requires statistical analysis to identify those variables in the data that can be historically validated as being the strongest predictors of successes. While at present these are most commonly defined as assignment outcomes, TIS has evolved models or a predictive analytics framework to predict the performance of an employee based on information captured through custom build portals for aligning work done data with performance KPIs, safety incidents, human error enhanced through existing EPM data. One of the commonly used models by TIS in predicting time-to-failure due to human errors is developed using Weibull distribution probability modelling. The parameterised distribution for the data set can then be used to estimate important life characteristics of the human reliability such as probability of a process failure at a specific time, the mean life and the failure rate. TIS does the life data analysis using:

- Gathering life data for human error in various processes in their life cycle till date.
- Selecting a lifetime distribution that will fit the data and model, the life of the employee or the operator.
- Estimating the parameters that will fit the distribution to the data.
- Generating plots and results that estimate the life attributes of the employee, such as the probability in following SOP, accuracy of work,
These approaches are designed for generic learning environments that are agnostic to subject matter. However, if one constrains the scope to a specific topic, new kinds of analytics are possible.

Predictive analytics are further expanded into:
1. Adaptive and Immersive learning analytics
2. Social/Organisational Network analytics
3. Discourse analytics

Adaptive and Immersive Learning Analytics

Immersive and adaptive interventions like game and simulation-based learning have the potential to measure the path taken by different learners in terms of the time spent in different cycles, approach taken and complexity resolved. This enables fine-grained feedback (e.g. what concepts have been adopted best in different levels), adaptive presentation of the content (e.g. not showing courses that the learner has already mastered or has failed). Naturally, dynamic modelling of the learner cognition, and preparation of the material for adaptive content engines are used to build better games and simulations. These analytics are also being used to personalise education and learning to employee based on their IQ, EQ and learning potential or sometimes factors that best fit their career paths in the future.

TIS has been working on MyPLE (My personal learning) framework in this direction.

Social/Organisational Network Analytics

Social Network analytics or Organisational network analytics makes visible the inter-relationship between employees at different levels. Social networks will heuristically form working groups that perform better as a virtual team as compared to organisational teams. The analytical framework helps develop a logical relationship between these groups and further helps instructional designers to understand how best to develop people.

Discourse Analytics

Traditional analytic models are based on structured data like how many times the employee has logged into a system, how many times the learner has visited a page in the knowledge management system, etc. In the age of personal blogs, websites, Facebook and Yammer, the social contribution and collaboration has become one of the key interventions in virtual learning. Discourse analytics is the starting tip point of big data
analytics and develops models to understand unstructured data. The results of these analytics help in dynamic recommendation engines which can provide a personalised learner’s page in a knowledge management system based on his / her current needs and focus.

Prescriptive Analytics

The pinnacle level of analytics is prescriptive learning analytics. Prescriptive analytics suggests the best option for handling future scenarios. In a full circle of Kirkpatrick model, the fourth level seeks to determine the tangible results of the training such as: reduced cost, improved quality and efficiency, increased productivity, employee retention, increased sales and higher morale. Prescriptive analytics is the best fitment to the fourth level of Kirkpatrick model.

Organisations have always faced challenges to device such models that can determine the critical return on investment (ROI) of their training expenditures. Predictive analytics provides the framework for forecasting the ROI and it is enhanced by prescriptive analytics that provides designers with the best option of designing learning and performance support.

TIS’ Learning Analytics Framework – (HEAT-PM)

TIS’ data analyst and training consultants have done significant work on the learning and performance management analytics model that integrates the highest level of maturity in measuring predictive human errors and develop prescriptive immersive learning and performance support systems. While this framework is largely focused on industries such as Manufacturing and Energy; TIS is investing significantly to make this framework agnostic to learning and performance management in all industries where human errors have a significant impact on business performance and getting optimal results. The framework is known as “HEAT-PM”; Human Error Analytical Training and Performance Model. The framework is represented in Figure 7. The framework’s primary objectives is to improve the performance standard of the employee by formulating a strategy of proactive training and reactively supporting with ‘as per need’ information at work. The framework is base-lined by:

1. Developing performance standards in TIS’ structured data system
2. Developing Human Error Taxonomy
3. Measuring Human Error and its impact on performance and developing it into a human-error model that can predict human error based on performance conditions
The framework is based on the assumption that:

1. Humans will create error
2. The errors can be eliminated but will be replaced by a new set of errors
3. Training assets are not exhaustive and there is a limit to their evolution and production
4. The biggest asset of an enterprise is its knowledge management system

Figure 7: Human Error analytical Training and Performance Model

The framework uses TIS’ analytics architecture to:

1. Measure performance gaps and provide intelligence on the root cause of failures
2. Prescriptive analysis with recommendation engine to provide adaptive learning to employee
3. Predictive analytics on performance failure and recommending the right sets of assets for performance support.

Further, the framework optimises the ROI of investment by:

1. Replicating similar assets between training and performance support system
2. Provide intelligence to the knowledge management system to aggregate data and prescribe as per need
3. Use of open source software like
   a. R for data analytics
   b. OWA for web-analytics
   c. BIRT, Shiny R- BI
   d. Hadoop file management system
A scenario

Consider a manufacturing organisation, which loses more than 20M$ every year due to human errors and another 10M$ due to low performance standards. The TIS HEAT-PM, in this scenario, starts by creating performance standards for the critical tasks set and starts measuring human errors within a defined metadata structure. The system can philosophically start with the basis that the errors are largely based on in-field experiences. The system will prescribe to invest in 3D-based simulation training on critical maintenance. These same 3D assets will be used to create virtual reality based performance support systems such as an oculus system that will guide the operator to use 3D image based standard operating procedures.

Figure 8: TIS’ learning analytics architecture

The loss of production in oil and gas due to human failures accounts for 50B$ loss per year. 90% of road accidents are also on account of human errors.

Organisations are slowly realising the value of investment in reducing human errors by predictive analytics.
Further, the system optimises the knowledge management system and brings to the operator’s learning page all the case studies, videos, and content targeted on optimal operations. It is predicted that TIS’ framework can reduce human errors by 50% on a year-to-year basis and improve performance to 80% as per the standards. The investment in a full-fledged similar ecosystem can be as high as 300%.

Advantages

TIS' learning analytics framework can work at multiple levels of an enterprise. The rich diversity of numerical, textual and semantic data that different techniques process, their impact on enterprise training could be profound when implemented systemically, with sound pedagogical design and the necessary business & learning analyst development to turn raw technologies into useful tools. The advantages at various levels include:

Micro Level Benefits

1. Provide learners as well as training teams with insight into their own learning habits and teaching methodology, besides giving recommendations for improvement
2. Identify at-risk employee or learners and provide scientifically based interventions
3. Dynamically improve performance standards

Meso Level Benefits

1. Improve administrative decision-making and organisational resource allocation
2. More transparent data and analysis could create a shared understanding of the industry segment successes and challenges
3. Make better sense of complex topics through combinations of analytics (e.g. from social, technical and information networks)
4. Support holistic decision-making through better understanding the impact of different variables
5. Increase organisational productivity by providing up-to-date information and allowing rapid response to challenges
6. Help leaders determine the hard (e.g. patents, research) and soft (e.g. reputation, profile, quality of training) value generated by faculty activity

Macro Level Benefits

1. Improve industry wide performance and training standards
2. Share best practices data and develop optimised academic model and pedagogical approaches
TIS’ Recommendations For Incremental Steps in Implementing Learning Analytics

TIS realises that an enterprise may face challenges to make the big leap into the third generation of learning analytics. TIS, has therefore, developed a micro learning analytics strategy that will bring incremental advantages. Some of the analytical services recommended by TIS in learning management include:

1. PLCS (Performance-based Learning Consulting Services)
   a. The gaps in the performance areas of the business processes are modelled and statistical analysis is done on an MS Excel-based tool. TIS consultants take these models to formulate data based learning strategy and create organisational development plan.

2. DLPM (Dynamic Learning Path Management)
   a. Analyses of the Learning and Development data in terms of effectiveness and correlation to employee profile. The model developed is used for analytics in adaptive learning.
   b. TIS enhances the model by providing portal integrated with HRMS and LMS that generates personal learning plan.

3. POCM (Point of Content Management)
   a. Content aggregation and integration architecture is deployed to augment the learning and training assets as per the need and interest of the learner.

Concerns & Issues

While learning analytics is the 3rd wave in data-based training, there are a number of concerns and issues that pose as a challenge for its growth and adaptability:

1. Watch Out: It may be threatening to some employees and enterprises to be aware that someone is continuously tracking their actions.
2. Holistic View: The success of learning analytics is based on high accuracy statistical model. Unlike other functions like sales or finance, the learner behaviour model is in its germinating stage. No matter how comprehensive the model is made, it is still difficult to capture and qualify some attributes and observations like ‘inter-personal skills’.
3. Integration: A critical need for learning analytics to be successful is to integrate it with ERP and EPM systems. Many CIOs still do not think of learning-based performance management as critical and may be resistant to introduce new systems in their current IT architecture.
4. Obligation to Follow Learning Intelligence Reports: The eventual output – be it in the learning path or course recommendation – is perhaps left to the faculty and learners to adopt. Unlike other functions where the results of analysis can be objectively stated, there is sufficient subjectivity to learning analytics and hence no one is really obliged to follow the machine recommended path.

Data privacy and the use of human capital confidential data are also strong concerns of Learning Analytics. There are legal, ethical and regulatory issues before use of such data. However, with all the above concerns in place, it is also imperative that enterprise performance management move up the ladder and catch-up with technological innovation that permits data based interpretation and better scientific results.

TIS has a well-defined path in mitigating the concerns. TIS’ methodology of implementation starts with creating workshops to measure KPIs, developing a pilot & analysing to establish the best statistical models and then deriving dashboards as per user need and security access.

Conclusion

TIS is clear in its roadmap that learning analytics is gaining momentum and is here to stay while maturing over the next decade. There are many benefits to enterprise learning analytics and organisations will gradually move from functional EPM to a hybrid model of learning and functional based performance model. TIS’ ability to harness the right set of data, transform data and use open source platforms to analyse data brings to our customers a high impact solution at reasonable investments.

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