

Cogito



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Cogito

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From the editor's desk

Nearly two months ago, IRIFM brought out its first issue of the institute's journal, Reverberations. It was a simple enough compilation of a few probationers' lockdown diaries, but concealed within it was an ambition. That it should lead to another kind of journal. One which may promote relevant research papers in a format in which they may be read with interest and used by railway accounts officers in their work. Well, said 'another journal' is here, and it still feels like this is not a technical enough journal. Just a precursor. An idea, an aspiration, a dream. That a different kind of writing may start in Indian Railways. About things that must be written so that a structured discussion may begin on ideas dominating IR's present, ideas which matter to the aging behemoth's very survival. A discussion which may inform railway policies constructively. And also a discussion on things that were so far in the zone of 'that which must not be said'. So Petrificus Totalus, Voldemort. And enter Generation X, Generation Y. To borrow from Dylan, come writers and critics who prophesize with your pen; and keep your eyes wide for the chance won't come again. And don't speak too soon for the wheel is still in spin, and there is no telling who it is naming; for the loser now will be later to win; for the times they are a-changing.

In his Principles of Philosophy, Descartes had suggested that the Cogito is the conclusion of syllogism whose premises include the propositions that one is thinking and that whatever thinks must exist. As a centralized training institute IRIFM has come into existence but recently. It has to think fast and intuitive, and also think slow, logical and deliberative to become relevant to IR. Have proclivity for loss aversion and the influence of intuitive impressions impacted our decision-making? Can we still look away from the analytics asset when our business has become too complex to navigate using the traditional white-pink file tied up with a draw string? What should our strategy be to regain our business share? What is the role of a railway division in this strategy? Is privatization of rails viable in the absence of an independent regulator? Is it time for wet-leasing train sets? Should IR buy open access power rather than continuing with state power utility bodies? These are the ideas giving the first issue of Cogito its breath of life. To become a railway journal which aspires to enjoy a national reputation for excellence in independent scholarship and critical inquiry, the Journal needs its readers' support in the form of ideas as well as patronage.

Cogito can come to occupy a special place in the railway landscape only if the academics, researchers, policy makers, and independent thinkers within IR (yes, they all exist even if under different names) would enable the Journal in becoming a forum for an exchange of ideas across departments, ideologies, and hierarchy by contributing to it. I have enough optimism and trust in the railway fellowship to hope that the Journal will be accepted, nurtured, and made spontaneous as time goes by. That it would become an innovative platform that aggregates select articles about IR from a wide array of sources in addition to producing original content. That it would make way for intelligent gossip, self-criticism, and objectivity. And O, that it may live forever!

Smriti Verma
Director, IRIFM

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Who's afraid of IRFC?

C. Jayasharadha

*"A little learning is a dangerous thing.
Drink deep, or taste not the Pierian Spring;
There shallow draughts intoxicate the brain,
and drinking largely sobers us again."*

Alexander Pope

The first week of classes at IRIFM were full of 'Introductions', most of which fell on either end of the spectrum between mundane and befuddling. So, it was with the benign interest of an outsider that I, along with twenty-five other IRAS probationers, sat in the classroom where we were introduced to IRFC. At first, the concept seemed simple enough. IRFC is a financing institution that provided a conduit for Indian Railways to mobilize resources through market borrowing. We were already much too familiar with the financial woes of Indian Railways, the decreasing share of government funding, the ever-burgeoning requirement for capital investments and the impossibility of funding the requirements through internal revenues. External commercial borrowing was a natural antidote to the paucity of funds. After all, all of us probationers, irrespective of our professional backgrounds, understood the concept of credit fairly well.

Soon, IRFC began to make cameos in every other introductory class, mostly hidden in the responses to our doubts about ownership, cost, financing terms and expected returns on investments. We were told that in order to cap the direct government liability while maintaining the pace of inducting rolling stock, IRFC was created as a PSE (Public Sector Enterprise), an NBFC (Non-Banking Finance Company), and an IFC (Infrastructure Finance Company). The relationship between IRFC and the market it borrowed from was traditional. IRFC borrowed funds to acquire assets that gave enough returns to finance the loans. This made the relationship between IRFC and IR, rather unconventional, at least to us novices. IRFC would have to own the rolling stock and lease it to Indian Railways for a fee. The same amount that was "interest" to IRFC was "lease charges" for IR. Indian Railways didn't own most of the trains. This was a strange enough proposition to warrant the renewed interest, bordering on obsession, that a few of us took in IRFC. Soon, with me bearing a large share of the guilt, classes on various topics were hijacked and turned into a chaotic discussion about IRFC and "exactly how much of Indian Railways it owned".

On the day we were visited by the FC, an unassuming instructor saw his class descend into a rapid question and answer session about IRFC. We had recently learnt that IRFC had also begun funding the capital investments of railways along with the rolling stock purchases. The "interest" burden on the IR books however, remained unchanged. So, technically the capital assets created by and for Indian Railways were also owned by IRFC and "leased" to Indian Railways. The instructor, unaware of the hours we had spent curating our questions on this subject seemed impressed at the class's interest in IR's operating lease agreements with IRFC, a topic which, according to him and the FC herself, was an evolving source of concern and complexity for all. If the agreement was that of a financial lease instead of operating lease, then the asset would appear on the IR balance sheet as asset and on IRFC balance sheet as loans extended. A quick glance at the IRFC balance sheet

confirmed that this was indeed the case. Even though there were some disconcerting mentions about “porting” project assets from operating lease to financial lease that kept cropping up.

Just when our existential concerns about who owns Indian Railways began to wane, we were burdened with newfound knowledge about government accounting and its extremely tenuous relationship with the concept of asset valuation. “IRFC follows a leasing model to finance the rolling stock assets and project assets of Indian Railways. The lease period is typically for 30 years, comprising a primary component of 15 years followed by a secondary period of 15 years. As part of the lease, recovery of the principal component and interest is affected during the primary lease period and at the end of the lease, assets are typically sold to the MoR for a nominal price.”, reads the IRFC website. Given the numerous elements that go into asset valuation and the total disregard shown by government accounting to most of them, how would a “nominal” price be arrived at between MoR and IRFC? “IRFC is a Schedule ‘A’ Public Sector Enterprise under the administrative control of the Ministry of Railways, Govt. of India.”, another line straight from the IRFC webpage was where the answer lay. IRFC was an instrument of the Ministry of Railways, an integral entity completely aligned with the overall goal of Indian Railways. Its identity as a separate entity, a PSE, was merely to distance the loans from the tag of government borrowing and allow it ample flexibility to diversify its portfolio and secure the best possible interest rates. The logic of its existence stemmed from the logic of corporatization that was undeniable. After all, the identity issues that followed the incorporation of Indian Railways as “a departmentally run commercial organization” can be blamed for much of its current financial woes. Once again, with greater understanding, our concerns about IRFC, a Leviathan that now seemed more Hobbesian than Old Testament, began to wane.

In our Foundation Course at NAIR (National Academy of Indian Railways), the topic for debate finals was “Should Indian Railway be privatized?” It was a close debate, with both sides armed with numerous case studies and statistics from across the globe, that often seemed to simultaneously argue for and against the topic. Discussions about privatization often ended up being discussions about the latest proposal for over a hundred and fifty private trains to be run across the country. DFCCIL was another sub-category of significance. Given the “foundational” aspect of the course, those sub-categories seemed very pertinent, and nearly exhaustive. But within the seemingly more advanced classrooms of IRIFM, they seemed less significant, trivial even and to those of us most afflicted by the IRFC obsession, they seemed like insidious distractions placed in the media to divert attention from the impending IPO (Initial Public Offering) of IRFC.

A few of us were preparing for the upcoming UPSC CSE personality test, fully aware that discussion about “privatization” were a near certainty in the interview. We were determined to arm ourselves with a unique “insider” perspective; to shed light on how vital it was to retain full government control over IRFC, the umbilical cord of IR financing. The only reason Hobbes’ Leviathan seemed less monstrous was that it embodied the “State”, a superstructure of collective will, built on the foundation of democracy. The relationship between IR and IRFC already seemed so volatile, dynamic and tenuous. Was there room for involving private shareholders in this equation? Could we keep the interest of the two institutions aligned when corporates were given sway over one? Did the agreements have enough clarity to look “profitable” to the private eye? How “nominal” can IRFC’s selling prices to MoR be, given the induction of private interest?

These questions continue to trouble me now, as they did over six months ago when they first cropped up in my mind. The concerns continue to wax.

"If the only tool you have is a hammer, you will start treating all your problems like a nail."

-Old Adage often attributed to Abraham Kaplan

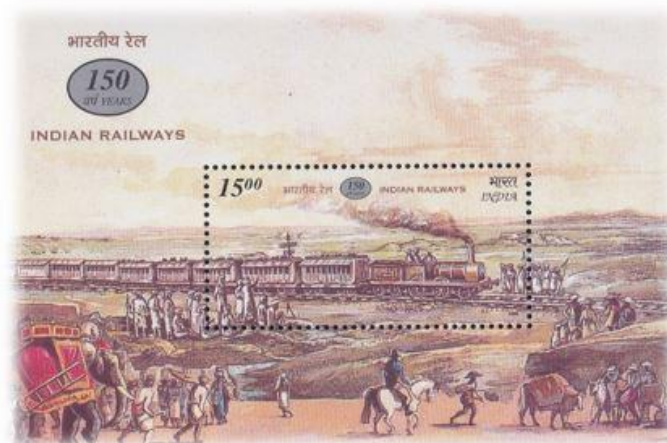
In the second month of training at IRIFM, we were each given an assignment to present what we had learned about different topics. My topic was "Voted and charged expenditure". Given that every single person in my audience was a proud and tired owner of a battered copy of M. Laxmikanth's "Indian Polity" each, I was quite anxious to give them a new perspective into these old topics. So, donning my brand new, infant-sized, "accounting" hat, I poured through the budget allocations of IR and tried to map the expenditures to their respective constitutional buckets of 'voted' and 'charged'. One of the underlying philosophy of charged expenditure is fulfilling sovereign commitments. That, "The debt charges for which the Government of India is liable, including interest, sinking fund charges and redemption charges and other expenditure relating to the raising of loans and the service and redemption of debt", will be a part of the charged expenditure is a constitutional mandate. The accounting norms of Indian Railways mention three sources of charged expenditure: Salary, Allowances and Pension payable to or in respect of CAG of India; any sum required in satisfying any judgement, decree or award of any court or arbitration tribunal; and any other expenditure declared by the constitution of India or by Parliament, by law, to be so charged. But the class where we were taught Voted & Charged Expenditure had one more point "Interest, sinking fund charges and redemption charges on loan and debts" that loomed over the other three points. When I noticed this difference between what was in the documented procedure versus what was taught to us, the conspiracy theory centre of my brain lit up again.

I crafted my entire presentation to emphasise that IR's charged expenditure was merely Rs 563 crores, while its voted expenditure was a whopping Rs 4,40,000 crores. I highlighted the little dots, in place of numbers, in the budget document next to 'Appropriation to Debt Service Fund' and contrasted it with the Rs 976,61,00,000 next to 'Lease/Hire charges to Indian Railway Finance Corporation' that was put in the 'Voted' expenditure bucket. I reiterated that calling "interest", "dividend" vis-à-vis GoI and "lease charges" vis-à-vis IRFC, has distorted our recognition of debt liabilities. The audience was half amused and half irritated that I had managed to transform yet another unrelated discussion into a rant about IRFC.

We were all well aware that this was a deliberate design that attempts to serve interests of all parties involved: IR, IRFC and GoI. What we were unsure of is whether this design was in line with the other transformational ideas we were introduced to in the training. For instance, how will this deliberate obfuscation of financing costs allow us to truly shift to corporate accounting from government accounting? Over the months we had heard enough about the lacunae in government accounting to see the difference between government and corporate accounting as that between real and reality. There was a near consensus about the need to corporatize IR though "privatisation" was still a hotly debated topic. What more, all of these transformative changes seemed to be already underway, especially the shift to corporate accounting and the restructuring of different functions into discrete autonomous quasi-corporate units. All these shifts need us to recognise our financial position with the clarity and discipline of the private sector. This recognition needs us to remove the obfuscations in our relationship with IRFC.

As I write these words, I am acutely aware of my position and expertise, or the lack thereof. The title of the article pays an homage which in itself is a derivative of Edward Albee's play – (Who's afraid of Virginia Woolf) to Frank Churchill's Big Bad Wolf (which in itself is a derivative of Edward Albee's play – Who's afraid of Virginia Woolf), a song that exemplifies the arrogance and bravado that is rooted in a child-like ignorance which disregards an imminent threat. This is, in part, to emphasise my personal fear about hidden issues with IRFC, its relationship with IR and its impending IPO. At the same time, it is, along with the opening quote by Alexander Pope, an emphasis on my position and child-like ignorance that undoubtedly denies me all claims to depth of knowledge or understanding, and instils in me a constant recognition that my fears might be overtly alarmist. This disclaimer, though unnecessary to the more experienced of readers, is the only condition under which I can place this article, a chronicle of my personal journey in understanding IRFC, in a technical magazine meant for a more knowledgeable audience. But one thing that I can say with confidence, is that more classes focussed on IRFC at IRIFM will be consumed with the interest and thirst befitting the Pierian Spring.

C. Jayasharadha (since migrated to IAS 2019) worked in the oil and gas sector for six years before joining the 2017 batch of IRAS. She has diverse interests, among which are classical dance and reading.



The analytics asset

Rahul Saxena

Abstract

A leading professional body, INFORMS, defines Analytics as: “the scientific process of transforming data into insight for making better decisions” (Robinson, 2012). The term has had wide usage and is most closely associated with the use of computers to process data to help make better decisions. The technology side of Analytics gets support from Computer Science and Information Technology. Its data analysis techniques are honed by the disciplines of Statistics, Operations Research, Decision Analysis, Industrial Engineering, Accounting, Finance, Economics, Systems Science, and Data Stewardship.

We can treat analytics as a multi-discipline profession because the body of knowledge required for analytics has become extensive, and businesspeople have started to designate teams and departments as being specialists in Analytics. An ecosystem of service providers has evolved for this profession, including conferences, degrees, professional consulting services, certifications, etc. Analytics is best understood as an organizational asset that is used to improve decision-making and execution. This chapter outlines the analytics landscape and aims to help organizations gain a shared understanding of issues that must be addressed to plan, build and use the Analytics asset.

A brief history of Analytics

The INFORMS definition of Analytics as: “the scientific process of transforming data into insight for making better decisions” is broad. Analytics has come to bear finance, operations, and economy connotations only since late last century. Mid-century references are mainly to Aristotle’s philosophy, and in 1940 the book titled “Brief Course in Analytics” related to geometry (Hill, 1940). Searching Google Scholar for papers with “Analytics” in the title, one appears in The American Economic Review in 1957 (Bator, 1957), and then it starts popping up in other economics journals (Tedford, 1964). It was used in the domain of decision analysis when, in the 1970s, Thomas L. Saaty labeled his technique for analyzing complex decisions as the “analytic hierarchy process” (Analytic hierarchy process, n.d.), and in the same decade it started getting used in medical and engineering journals.

The Systems and Procedures Association of America (SPA), chartered in 1947, gave impetus to industrial engineering and operations research. The members of the association called themselves the “systems men”. The systems men quickly aligned to the use of computers in government and companies. The “management information system” (MIS) concept debuted in 1959 at a conference sponsored by the American Management Association (Haigh, 2001). The MIS concept, a grand design for data-driven management, can be treated as a predecessor for “analytics” for the industrial engineering and operations research communities. By 1968 it was already facing a backlash from being overhyped. In the 1980s, terms such as managerial computing, decision support systems (DSS), or executive information systems (EIS) served to rebrand and de-scope the MIS idea into more feasible applications.

Progress in technology, however, was making the enterprise-wide dreams of MIS feasible. In 1988, IBM researchers published the first paper for an “enterprise data warehouse” (Devlin, 1988), and in the 1990s companies constructed expensive data warehouses (DW). The Data Warehousing Institute (TDWI) was founded in 1995. The “business intelligence” (BI) term was brought into use in the late 1990s as a label for new reporting technologies, and both BI and DW became aligned to the Information Technology discipline.

The return of “artificial intelligence” (AI) is the big change for Analytics today. Along with “machine learning” (ML), an AI technique, it has become a huge part of the Analytics conversation, overshadowing other aspects. AI is associated with the computer science community, and while AI technologies steadily progress and permeate the economy, they are also subject to boom and bust cycles (History of artificial intelligence, n.d.).

Analytics, therefore, is used by different disciplines to deal with analysis and decision support. The “systems men” differentiated into Operations Research, Decision Analysis, Industrial Engineering, Systems Science, and Information Technology (IT). The leading institute for advanced analytics and operations research, INFORMS, traces its roots back to 1952 (Horner, 2002). The American Statistical Association (ASA) was founded in 1839 and statistics is pervasively used in data analyses. In drawing sets based on the stated aims of academic disciplines and the aims of Analytics, we frame Analytics as containing Statistics, Operations Research, Decision Analysis, Industrial Engineering, and Accounting, and overlapping with Finance, Economics, Computer Science, Systems Science, Data Stewardship, and Information Technology.

Since tech waves are used to drive markets, the branding labels for Analytics update accordingly. The past decades have seen MIS and DSS drop out of favor while BI, Analytics, AI, and ML rose.

The Analytics Trend

Improved access to data, better prepared business organizations, and a large knowledge base of techniques and algorithms has led to increased adoption of analytics. As IT systems have evolved and become widely used, we have gained unprecedented ease of access to data. Databases are used to track transactions and processes using applications such as e-commerce, enterprise resource planning (ERP), customer relationship management (CRM), logistics, inventory management, human resources, marketing, etc. Government and stock-market data is available for online access. Data gathered by web-crawlers and social media platforms (such as Facebook, Twitter, LinkedIn, etc.) enable us to use even more data to make decisions.

We have learned to expand the areas in which analytics can be applied. Management practice has evolved towards increasing use of business processes and project management methods and become more sophisticated in setting and tracking objectives. People are better educated, more aware, and less reliant upon one skill or one employer with whom they expect to spend their whole working life, so they may be more change-oriented or less resistant to the changes driven by analytics. As the use of analytics brings greater visibility and accountability and reactions against it are encountered (Schrage, 2013), though, we can draw upon learnings in change management to address them.

Analytics techniques have evolved and variegated to better match the business scenarios in which they apply. You can access thousands of professionals and academics, and read myriad papers in journals on operations research, statistics, decision analysis, and management science, techniques. Algorithms have become better at solving complex optimization problems that would slow earlier systems to a crawl. Take the example of CPLEX, a widely used suite of optimization algorithms. A production planning problem that took 29.8 days to solve in 1988 ran in 59 seconds in 2003, more than 43,500 times faster. In 2020, we can expect optimization algorithms to run on request and return results nearly immediately to the requestor. At present many discussions about analytics capabilities deal with adding AI, managing privacy, and disrupting industries. The trajectory of optimism in this technology continues. The fight against fake news and social media addiction is not tainting the analytics disciplines they use.

New labels such as AI Specialist and Data Engineer are being floated to describe the Analytics talent requirements (LinkedIn, 2019). Data management technologies are being augmented to handle the larger volume and flowrate of data that analytics demands. Data management used to be about SQL databases, data loading, data quality, data warehouses and data marts, statistics, optimization, simulation, dashboards, reports and alerts. To this we now add a slew of new technologies such as Apache Spark, graph databases, in-memory processing, and deep learning.

Three stages of Analytics

There are three stages for analytics (Saxena & Srinivasan, 2013) in organizations, and each stage includes an interplay between analytics technology and techniques.

In the first stage, organizations use databases, dashboards and reports to get the information needed to help make decisions. The assumption is that the decision-makers know how to use the analytics provided. This stage is heavily data oriented, as decision models can remain implicit in the mind of the decision-maker. IT teams to specify, develop, use, and evolve dashboards, reports, visualization and querying tools. The IT team is often designated as “business intelligence” (BI), “data warehousing” (DW), “Analytics”, or “artificial intelligence” (AI), and can sub-divide into specialists in designing data models, managing metadata, loading data into databases and transforming it, user experience designers, report/dashboard developers, etc. There exists an entire ecosystem of IT tools and services providers to serve these IT teams.

In the second stage, people turn to analytics professionals to help make sense of the data, conduct analyses, generate insights, and to make recommendations. This stage adds model orientation to data orientation, as analytics professionals document models to explain to their clients. Here we encounter the emergence of analytics professionals who provide a second source of analytics supply for decision makers, other than IT. These analytics professionals may be housed in businesses, IT, or a separate staff function – or in all these locations for large organizations. A new set of systems and processes support the Analytics teams. This has given rise to an Analytics ecosystem that works in parallel with the IT-oriented ecosystem. Analytics teams place a different set of demands on IT to serve their needs, mostly formulated in terms of broad data access – Analytics people want IT to enable them to get the data they need, and then they will perform the analyses they wish. Sometimes IT also provides the analytics infrastructure and supports Analytics applications.

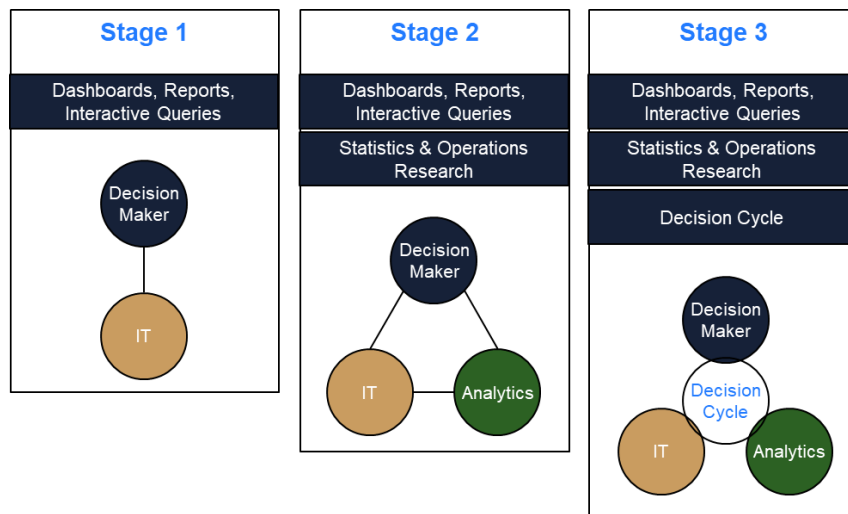


Figure 1: The three stages of analytics

In the third stage, decision-makers, analytics professionals, and IT work together to create, use, and evolve decision cycles for the organization. Decision cycles go from decision-need to outcomes, and help you drive results from analytics – this stage is results oriented. Analytics becomes embedded in organization practices and becomes an asset that can be assessed and continuously improved.

The zeroth stage, of using data analysis as a personal tool, is not included in these three stages as it is indistinguishable from the history of making informed and thoughtful decisions that may be treated as a hallmark of human civilization. Each stage adds to the previous stage and generates greater value. All these stages exist in parallel, aligned to decision needs. The presence of specialized Analytics teams in organizations denotes movement out of the first stage. As such teams are commonplace, we can mark most organizations have progressed beyond the first stage of Analytics.

The use of information technology (IT) in Analytics is foundational. It is incorporated in the Analytics ecosystem, tracing back to the Systems and Procedures Association of America (SPA) in 1947. In Stage 2, we see people invest heavily to increase their Analytics capabilities. The huge investments flowing into Analytics led to the creation of new providers and ecosystems. The seeds often came from the more quant-oriented businesspeople and the more business-oriented IT teams, re-grouped and re-designated to create “analytics” teams. In the analytics ecosystem we see a host of new entrants as well as a bunch of pre-existing players such as BI technology providers, as well as Statistics and Operations Research professionals. The big question these Stage 2 organizations deal with is how to create and manage an analytics supply capability.

For Stage 3 organizations the big question is how to make the analytics capability drive results. To do this, they designate decision cycles as assets that can be created, used, stored, and evolved like other assets. Dr. Davenport suggested that organizations should take an inventory of decision needs (a decision inventory), determine how they should be made, and institutionalize the decision process (Davenport, 2009a). We will call this the decision cycle.

In a different paper also published the same year he describes the use of the experimental method to refine and evolve decision models that has taken root in leading organizations (Davenport, 2009b) such as CapitalOne, Subway, Google and Amazon.

Business Analytics and Consumer Analytics

Our minds work in two ways, labeled as System 1 and System 2 (Kahneman, 2011). System 1 operates fast, without conscious thought, and feels smooth. System 2 works slowly, and you are aware of devoting attention to think about the situation and the experience of making a choice. behavior in ways that are opaque to the consumer. Traditional moderators arising from interpersonal interactions grounding people into other people's real situations and shared experiences get edged out by individual experiences delivered via personalized screens on your favorite machine (mobile phone, television, etc.), and these experiences can be managed to generate the results that the consumer analytics practitioners desire.

Consumer Analytics for political gain

Politicians and practitioners of state power have long understood the power of influencing the public using effective communication, propaganda, and disinformation. The increasing availability of analytics to influence public opinions, attitudes, activism, and votes is an irresistible lure. The creation of political factions and loyal supporters has a long history, and now includes the use of consumer analytics techniques.

"The conscious and intelligent manipulation of the organized habits and opinions of the masses is an important element in democratic society. Those who manipulate this unseen mechanism of society constitute an invisible government which is the true ruling power of our country. We are governed, our minds are molded, our tastes formed, and our ideas suggested, largely by men we have never heard of.... It is they who pull the wires that control the public mind."

— Edward Bernays (Bernays, 1928)

"The picture of the world that's presented to the public has only the remotest relation to reality. The truth of the matter is buried under edifice after edifice of lies upon lies. It's all been a marvelous success from the point of view in deterring the threat of democracy, achieved under conditions of freedom, which is extremely interesting."

— Noam Chomsky, Media Control (Chomsky, 2002)

The disinformation campaigns in political consumer analytics sometimes surface as "Fake News" or misinformation. The effectiveness of fake news to sidetrack real information and to plant the desired attitudes makes it a useful tool. Empathetic stories, shocking facts, and other sugar-coated pills are used to continue keeping your faction loyal and energized, and to sow confusion in opposing factions.

The result of effective consumer analytics to drive political gain confers advantage to its practitioners, leading to an arms race where all parties hoping for relevance and power use it. Analytics and automatons (often called "bots") are used to craft and promote information streams to consumer segments.

As we write this article, the use of AI is forecasted to make both Analytics and bots more effective AI can generate content, direct it to the right audiences, and run test-and-refine loops with unprecedented scale and accuracy. AI in bots can better seed and promote

content in such a way that human conversations are increasingly permeated and directed by analytics practitioners. This includes amplifying a selected view, confusing opposing or competing views, and trolling counterattacks.

Business Analytics

Business analytics is about making better decisions. Good decisions use data analyses and informed advice that leads to the desired results. We can call it organizational intelligence or other terms to connote the idea that good decisions need to be made in non-business contexts too, but for now the term “business analytics” is used and understood as being widely applicable.

Focus and Specialization are used to enable better decisions. It's usual for organizations to have teams in divisional and functional structure. Teams enable focus (on a line-of-business or a region) and specialization (in accounting, sales, service, etc.). This is the foundation for intelligence in organizations. On this traditional layer, Transaction Systems automate workflows, such as procurement and accounting. The resulting standardization and control make work consistent and visible. It also makes workflows editable and provide places to implant additional intelligence. Analytics Systems layer on to collect and analyze data for decision support.

In contrast to consumer analytics, business analytics tries to combat biases and promote rationality in decisions. Such rationality is grounded in enabling people to collaborate effectively, using mindsets, systems and processes that provide the best outcomes. Instead of trying to bypass or diminish the role of critical thinking and thoughtful weighing of options, as consumer analytics does, business analytics tries to accentuate it. As you may expect, it's less fun to use business analytics than to be swept unthinkingly along with the flow of consumer analytics.

The field of business analytics also sees improvements in tools and techniques that make it both affordable and effective. The use of business analytics to set and navigate towards thoughtfully conceived and continually assessed objectives provides organizations with the ability to solve problems and drive human advancement. We may worry, however, that successful organization-wide business analytics can create an intelligent and adaptive entity that can devour its competitors, conquer industries, and outmaneuver regulators.

The return of AI

AI or artificial intelligence has re-emerged as a buzzword that subsumes and dominates conversations on analytics. We can think of AI as the discipline that makes intelligent software agents (Russell, 2010). Most of the current fascination with AI is driven by advances in machine learning, computer vision, and natural language processing. The "Artificial Intelligence Index Report" depicts AI as a branch of Computer Science (AI Index Steering Committee, 2019), and also as a general purpose technology with impacts across industries and functions.

Applications of AI include Analytics, speech recognition and translation, image recognition, robotics, autonomous driving, medical diagnoses, etc. The problem of defining AI is not directly addressed, and there is no wide consensus on this. AI practitioners are expected to recognize the difference between AI and non-AI tools.

The applications of AI in Analytics and the semantic overlap between intelligence and analytics makes these two fields overlap heavily in the popular perception, the press, industry, and academia. Gartner's "AI business value forecast" projects that decision support/augmentation and decision automation constitute the largest type of AI by business value-add, and that by 2030 they will account for 63% of the value-add (Gartner, 2019).

AI is an exciting idea, and AI hype has risen before, only to disappoint and collapse into "AI winter" periods when interest and funding for AI reduces (AI winter, n.d.). It fell so far out of favor that in the 2000s its practitioners used other labels for their work, even after IBM's Deep Blue beat Gary Kasparov in a chess match. Advancements continued, and the term has come back in full force, such that some Analytics practitioners are now seeking to position their disciplines as included in AI.

INFORMS, representing the Operations Research (OR) and Decision Analysis (DA) communities, has released a white paper on its positioning in the AI conversation (INFORMS, 2019). They position AI as providing complementary tools to make OR and DA more effective. More market-oriented entities simply rebrand Statistics as AI, both to satisfy customers seeking AI knowledge and in acknowledgement of the fact that AI depends on Statistics, OR, etc. for the techniques to develop intelligent software. Thus, Coursera's AI Taxonomy depicts Linear Regression under Machine Learning, and Kaggle's State of Machine Learning and Data Science 2019 survey questionnaire includes Linear Regression and Logistic Regression in their list of ML algorithms.

Inclusion of Linear Regression and Logistic Regression in ML and thus in AI makes it overlap heavily with Analytics, and this overlap is exacerbated by including Expert Systems (conflated with decision support systems). Autonomous intelligent agents are conflated with non-AI software. AI overlaps with both analytics and transaction systems software makes it like "digitization" or "software" in the general usage. The software ecosystem is happy to claim a stake in AI while the going is good. The replacement of older-generation analytical and transaction system software into a set of intelligent agents is being talked up. The AI conversation has started to acknowledge the central role of a "decision factory" in assisting and maximally automating decisions and transactions, and of adding intelligence into transaction management and workflow automation systems. People have not yet taken the clear position that the future of intelligent software agents consists of one, CoBots (collaborative bots); autonomous intelligent agents (bots) that can collaborate with other bots and two, working seamlessly together in a CoBot System

We think that AI (defined as intelligent software agents) will permeate and transform IT, and that Analytics teams will use the AI-infused IT to add scale, scope, effectiveness, and efficiency. The INFORMS white paper on AI provides support for this view: intelligent software helps any discipline that can make use of these new tools. OR, DA, and other constituents of Analytics continue to have relevance in the aspects that they're focused on.

Data Science and Analytics

The "Data Science" label has sometimes been conflated with Analytics. Data Science is stated to be an interdisciplinary field for the analysis of structured and unstructured data using specialized algorithms and software such as data mining, machine learning, image processing, natural language processing, large-scale data visualization, etc. to gain insights, make predictions, and enable decisions.

This definition of Data Science has already run up against AI that provides the tools and techniques for machine learning, image processing, natural language processing, etc. The debut of the “AI Specialist” job title at the top of the emerging jobs report for the Machine Learning, Deep Learning, and Natural Language Processing skillset (LinkedIn, 2019) is a call for Data Scientists to differentiate themselves. Studying the actual role of Data Scientists, we find that the role is already decomposing into constituent techniques, and it is likely that Data Science may end up as a professional specialization either under Statistics as a job description for people who train and maintain Machine Learning (ML) algorithms or under Analytics has already split into two major branches along these lines. Business Analytics intends to drive intelligent decision-making and runs up against competition from biases and unconsciously rooted behaviors. These same biases and unconsciously rooted behaviors are leveraged by Consumer Analytics to unobtrusively drive behaviors. Consumer Analytics has taken flight. Its effectiveness for influencing consumer behavior is making people wake up to questions of manipulation, addiction, and privacy.

Consumer Analytics

The quest for effective messaging to the public has deep roots, and the discipline has built a body of knowledge for making it work. Back in 1928, Edward Bernays explained how public communication can use learnings from social science and psychological manipulation in his book “Propaganda”. He is celebrated as the “father of public relations”, and he worked for business such as General Electric, Procter & Gamble, American Tobacco Company, for media outlets such as CBS, and politicians such as Calvin Coolidge.

Bernays famously worked on the campaign to promote smoking by women in the US, converting a social taboo to a symbol of emancipation. He helped the cigarette industry to effectively engineer the consent of women to become smokers (Brandt, 1996). He organized a publicity stunt of historic significance when he got debutantes to march in the 1929 New York City Easter parade brandishing their cigarettes as “torches of freedom.”. His ideas were also used by others, famously by Joseph Goebbels of the Third Reich.

Nearly every aspect of our lives has the potential to be touched by consumer analytics. The act of presenting a diamond ring to signify an engagement was, after all, the outcome of a successful advertising campaign by a diamond company. Information enters us from a multitude of channels (laptops, phones, radio, television, movies, billboards, etc.) and can be engineered to influence us, often to drive sales.

The quest for sales via consumer analytics has benefited from the combination of nearly ubiquitous internet access and widespread screen availability. In a 2019 estimate, US adults spent more than 12 hours on digital media every day (Dolliver, 2019). These audiences are analyzed and carved up into segments for marketing to influence attitudes and behavior.

As analytics for consumer engagement becomes increasingly more effective from continual refinement, the rewards for consumer analytics practitioners are reaped in terms of business benefits from increased customer loyalty, higher revenues and better profits. Customers become “fanboys”, passionately engaged with their brand.

The entire consumer marketing industry is now oriented towards more consumer analytics. Apple enjoys a devoted customer base. Facebook, Apple, Amazon, Netflix, and Google are known to effectively analyze consumer behavior to drive revenue. As companies get better at it, the winners create customer bases that are addicted to their brands, services, or products. The change from engagement to addiction is real. You can find journal articles exploring Facebook Addiction Disorder (Brailovskaia J, 2018). The penalty for not deploying an effective consumer analytics capability is to face losses to competitors who poach customers and opportunities.

On the traditional layer of mass media, public relations, advertising, politics, and economics to influence audiences, we have now added the layers of social media systems and analytics systems. These systems provide unprecedented opportunities to influence consumer Decision Analysis as a job description for people who rapidly visualize and analyze data. Given the ill-defined and changing nature of what Data Science represents, its overlap with Analytics and AI, and the fact that sophisticated algorithms and software technologies are innovated and used in all the sciences, it is not useful to define Data Science but to watch for what it evolves into.

The Data Cycle: from data to insights

Information Technology (IT) is used to acquire, process, store, access, and disseminate data. From the days of MIS, Information Technology (IT) has been the foundational enabler for Analytics. The role of IT in Analytics is to build and run the Data Cycle.

Analytics is now being applied to different kinds of data:

- Structured data in relational databases is the staple for analytics. This data is used in transactions such as placing an order, making a payment, updating a sales opportunity, or transferring funds. As more and more transactions are automated, each kind of transaction lends itself to analytics, and combinations of sets of transactions enable analytics across transactions that yield new insights.
- Unstructured data is of the kind characterized by books, documents, research papers, patent filings, HTML pages (such as those used in websites, blogs, etc.), newsgroups, Twitter postings, etc. Unstructured data also occurs as comments associated with structured (transaction) data, for example a customer support case is a transaction that generally includes free-text (unstructured data) that records the customer issue, as well as subsequent commentaries put in by employees who handled the case; or a product catalogs contain free-text descriptions of each product in addition to structured data about the product identifier, price, etc. Log files generated by computer equipment is another variant in this category, as such data is generated by an algorithm and so contains inherent structure, but it looks like unstructured text.
- Observations and control data come from sensors and controllers. This kind of data is critical for running oil refineries, chemical plants, factory-floor infrastructure, the electric grid, hospital equipment, etc. In many cases the data and related control algorithms have implications for safety, security, and health. Specialized technologies are used for managing this data, and it was used by engineers, laboratory technicians, and

other specialized professionals. Increasingly, nowadays, this kind of data is also being used for business analytics and starts to have importance for business leaders. GE, for instance, can create new sources of competitive advantage and revenue from analytics on its industrial products (such as gas turbines in commercial aircraft). The “Internet of Things” has become the brand for this category of data which includes data from Supervisory Control and Data Acquisition (SCADA), bar-code readers, Radio-frequency identification (RFID), Global Positioning System (GPS), Simple Network Management Protocol (SNMP) monitors, accelerometers, motion sensors, etc.

Video, sound, and images also lend themselves to analytics. Triangulation of the sound of a gunshot is used to locate snipers, and video feeds can get automatically tagged by a motion detection algorithm and prioritized for review by security personnel. As the analytics techniques to process such data evolves, it will also become more important for business analytics. Games already contribute to internet data traffic and may become used for analytics both as data sources and as immersive environments for conducting analytics. Other data includes MRI scans, other biometric imagery, genomics data, proteomics data, 3D image files, engineering design files, satellite observations, etc.

The data cycle that has six functions that transform data to insights. This categorization adds math models as a function that the data cycle needs to support, but otherwise can be viewed as a simplification of other such models, for example the ten functions in the DAMA Data Management Body of Knowledge or reference architectures published by various vendors and analysts.

Data loading functionality is required to move data from its source and into the analytics environment. A commonly used pattern for these systems was to “extract, transform, and load” (ETL) data: i.e., to extract data from where it resides, transform it to match the format demanded by the analytics system where it needs to go into, and then to load it into the analytics system. Variants of the pattern include “extract, load, and transform” (ELT) and the insertion of data-stages that can serve different needs from the same data flow.

Data storage functions are performed by database and file-management systems. Relational databases that support the Structured Query Language (SQL) to define and manipulate the data are widely used for managing structured data. The dominance of SQL can be gauged by the fact that all other data storage and management methods have started to get lumped under the label of NoSQL, which includes document stores, graph databases, object stores, etc.

Data quality management looms so large in importance for analytics that it deserves its own slot as a function. A huge part of the time and effort that goes into analytics is spent on assessing and improving data quality, many of the defects in analytics trace back to defective data quality. Think about data quality not just as fidelity to data sources but in terms of how sensitive your decision models are to variations in data quality regardless of where the quality was impaired.

Visualization and dashboards, Online Analytical Processing (OLAP), query, filter, and search functions are provided by a host of tools that process the data into cubes, tables, reports, charts and graphs. In many cases the label of “business intelligence” (BI) systems is applied to this category. A range of end-user interaction is permitted, from read-only to completely interactive methods for people to play with the data. OLAP tools, for example, enable users to roll-up (consolidate) data, drill-down, and filter (slice & dice) along any combination of dimensions such as geography, customer segment, product, etc.

Math modeling systems support analytics techniques such as statistics and optimization. These systems can run in the “inline” mode, where the algorithms must execute to provide timely guidance to the business process they support, for example to assess the credit-worthiness of an order as it is being placed by the customer, or in an “offline” mode where the credit-worthiness check occurs as a separate step after the customer places the order and the sales team can contact the customer if the check fails. As analytics systems become faster and able to process larger volumes of data, it becomes possible to deploy more math models in the inline mode of operation.

Metadata or master data management functions are used to manage hierarchies (such as who reports to whom, or how a precinct’s data rolls up to the district), and reference data such as customers, suppliers, products, employees, materials, etc. Master data or reference data is used across functions for different purposes, and metadata is the “data about data” that can assess if the data looks right and follows the business rules such as hierarchical arrangement, uniqueness (identify suspected duplicates), ranges (e.g., employee age), etc.

Since analytics is data that is built upon data, metadata and master data management takes on a key role. Analytics processes use, validate, update and create such data. The scope of this function is so large that it is better to call it ontology management. Leading organizations use semantic web technologies such as W3C’s Resource Description Framework (RDF) to manage ontologies.

The technology underpinning these analytics systems functions has evolved to support greater scale, richer functionality, faster processing, and deeper interconnections. These are often lumped into the “Big Data” category that consists of several different threads of technology evolution towards handling ever larger volumes of data.

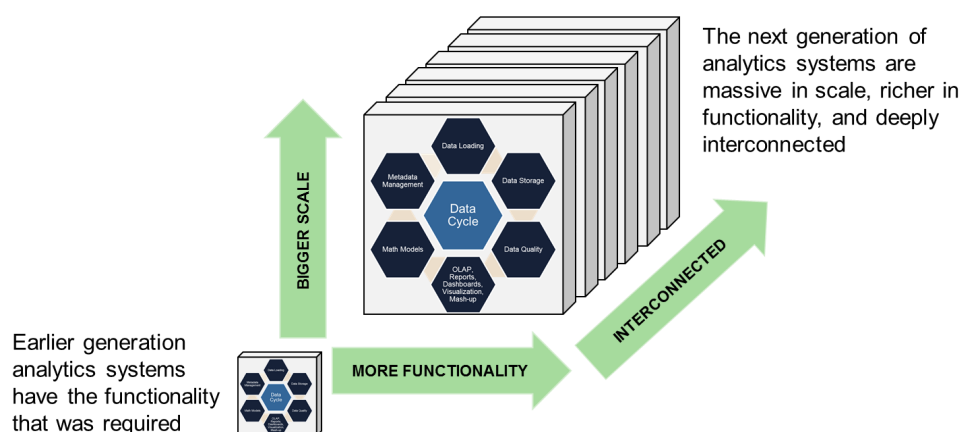


Figure 2: Analytics systems (© 2020, Cobot Systems Pvt. Ltd. Used with permission.)

Improved technologies enable the reliable processing of unprecedented volumes of data. Facebook, for example, claims to have more than 300 petabytes (each petabyte is a thousand terabytes) in their Hive database. Other database technologies have also increased their capacity to manage data volumes.

Ontology management tools enable seamless interconnection of data stores to handle the huge complexity of an enterprise-wide view of data, thus providing a path to design the next generation of data warehouses. Machine learning, data mining and data visualization technologies have become richer in functionality and faster in performance, adding to the speed of generating insights from the data. Agents and rules management technologies (rooted in the field of artificial intelligence) also make analytics systems smarter.

Faster processing of data in analytics infrastructures has enabled near-real-time speeds and support inline analytics operations. Technologies to do this include in-memory processing and column-oriented databases, as well as stream processing tools such as Apache Storm and Apache Spark. Faster speeds are also due to the improvements in speed and functionality in other parts of the IT stack such as faster CPUs and hard disk drives for storage. In addition to supporting big data, the current technology can support:

- Fast data: high rates of data flows into the analytics systems,
- Big analyses: complex analytical models, and
- Decision cycles: the use of decision models and test-and-learn processes.

As exemplified by the Apache projects, the leadership of these new technologies is often in the hands of open source and free software projects. Free and open source tools are available for each category of analytics systems. Not only do these technologies enable bigger systems with richer functionality and higher speeds, they also promise to lower the total cost of ownership as compared to older technologies.

This sea-change has occurred because people at business giants such as Google, Facebook, Yahoo, Twitter, etc. chose to open-source their technologies, riding on the trend of technology talent support for the open source movement. Basically a set of very smart people faced having to process a flood of data to do their jobs, and they solved it – they were computer scientists working on the new internet businesses, physicists working on collider data, astronomers working with telescope data, or healthcare professionals using scanner data.

The decision model

A decision model provides the method to frame a decision, state the objectives, define what information is required to make the decision, and how that information is to be processed to provide options and advice. A simple decision model can be used to figure out which box of salt to buy, given two options. Confirm that both boxes have the same amount of salt, of the same kind. Then choose the cheaper box. A more complex model may be used to compare white t-shirts, where the criteria can include price and brand. In general, decision models include criteria, options, recommendations, and scenarios.

A decision model can score the options and provide a recommendation, provide a method for the decision-maker to play with the model and assess the range of possibilities, provide procedures for getting to the decision individually or as a team, or any combination of these.

For use in Analytics, decision models are implemented as algorithms that provide solutions for a specific decision. To create the algorithm, the problem needs to be clearly defined and modeled – we can call this a decision model specification or requirement. The algorithm is then developed, tested, and deployed such that it meets the specification and provides useful solutions for the decision. The process may be iterative, as a unimplementable or insoluble specification can lead to changes in the specification.

In the absence of a decision model, the role of Analytics is limited to informing the decision maker, under the assumption that each decision maker knows how to make the decision based on the information provided, and perfectly converts that incoming information into a mental decision model of criteria, options, recommendations, and scenarios. As you may expect, the reality is that different people have different mental models, and the same person may process the same data with different results because of extraneous issues such as how hungry he is or how much time he has, the gender of the requestor, etc. In the absence of decision models, organizations face the cost of inconsistent decision making (Kahneman, 2016). The more insidious effects are that the secret of making good decisions remains inside the wetware of individuals and teams, thus subject to loss, impossible to replicate, and unavailable for systematic improvement. Implicit decision models need to be made explicit – written down and shared. With explicit decision models, decisions become consistent, collaboration based on decision models becomes transparent and accessible, decisions remain aligned to their design, and the decision model becomes subject to constructive criticism and adaptation.

Test and Learn

The systematic criticism and adaptation of a decision model is labeled the “test and learn” process. Each time a decision is made, we can check if the results were aligned with the objectives. It is a data-intensive and time-consuming process, but the effects are to scientifically and continually refine the decision model and keep it effective.

A/B testing is an example of the “test and learn” process being used in a case where decision model A is tested against decision model B. In general, A is the model that is currently used (or Champion) and B is a new model (or Challenger). For instance, the color of the “buy now” button may be currently green, and the challenger is blue. An A/B test, run as a randomized experiment for several cases, will reveal which color leads to higher rates of buying.

Design of Experiments (DOE) is the method used when two or more input factors influence the test. DOE is used to evaluate the effects of multiple input factors. In this way, we can identify interactions between inputs we’d miss when experimenting with one factor at a time. The statistical methods used for DOE were worked out by R. A. Fisher early last century.

A/B testing and DOE software is widely available and used, especially in marketing and manufacturing.

The Decision Cycle: from insights to results

Decision cycles provide the capability for Analytics teams to link the insights from data analysis to the decision and execution processes in the organization, providing a systematic way to go from insights to results. It also enables the systematic assessment of decision models to enable aligned, adaptive and responsive behavior across the organization.

The decision cycle has six components:

- Decision Models, the algorithms used to make decisions. This is needed to convert implicit decision models to explicit models..
- Analysis to Advice, the decision-support advice for a specific instance of a specific decision. This is needed to provide updated advice in every instance.
- Advice to Decision, to track how the advice resulted in a decision. This is needed to track and close the advice-to-decision gap.
- Decision to Execution, to track how decisions resulted in actions. This is needed to track and close the decision-to-action gap.
- Execution to Outcome, to track how actions resulted in outcomes. This is needed to track and close the action-to-outcome gap.
- Decision Inventory, to track how which decisions have models, and how the models align. This is needed to track and close gaps in models – to find places where decision models don't exist, where decisions are misaligned between different models. We may also call this set of decision models a “decision factory” (Iansiti, 2020).

To use analytics to make better decisions, you need to use decision cycles with explicitly specified decision models that are continually assessed and evolved in a feedback loop. This is the analytics asset that sets you on the path to increasingly effective decision-making. Decision models are open for inspection and continuous improvement, as compared to implicit or “gut-feel” decision making that is known to be rife with biases (Hamond, Keeney, & Raiffa, 2006).

Decision cycles track from need to outcomes, so we can learn from the feedback loop and use it to improve, adapt and evolve. The decision cycle applies to the full spectrum of decisions needs: from strategic decision-making to tightly constrained day-to-day operational decisions, and to everything in between. This is because in its lightest-weight implementation you can identify a business need in the inventory and use the decision model to record when and where the decision is taken, by whom, how it was executed, and what were the results.

Conversely, the lack of visible decision cycles inhibits the creation and usage of analytics. When decision cycles don't leave an easily accessible record, even organizations with good analytics teams use analytics as data-inputs or as just another point-of-view. Explicit models and decision records are needed for learning and improving the process of decision making, and the learning cycle is needed to assess and improve value. The demand for analytics becomes limited without decision cycles because decision-makers start to question the relevance and value of analytics deliverables that lack connection to decision support and business results.

The decision cycle can be compared to other methods such as the “OODA loop” (for observe, orient, decide, and act) of Colonel John Boyd, “Plan, Do, Check, Act” or the Shewhart cycle popularized by Dr. W. Edwards Deming, and DMAIC (define, measure, analyze, improve, control) used in Six Sigma. The decision cycle has a decision inventory, a set of decision needs that anchors the cycle to the business need. Decision models, analytics deliverables, decision instances, execution, and outcomes are implicitly needed in all of these cycles and are explicitly called out in the decision cycle.

Analytics for competitive advantage

We can think of analytics as the combination of the data cycle and the decision cycle. The concept of using analysis to produce insights from data is foundational, the advantage comes from using it in a decision cycle. It's in the coverage of the decision cycle where the definitions of analytics diverge. Four definitions for analytics are presented below and compared to their coverage of the decision cycle. In many cases, analytics practitioners may provide advice without using explicit decision models, so when the systematic improvement of decision making is not mentioned we give that approach partial marks.

We should select a definition of analytics that supports the decision cycle end-to-end. Accenture exhorts "Taking an issue-to-outcome approach is critical because it puts the focus where it should be: on tying Analytics directly to making decisions, taking action and delivering value for improved business performance. (Hernandez, Berkey, and Bhattacharya, 2013)" Following this guide, we have defined analytics as "the method and capability used to create value by systematically improving decision making and execution".

Having selected a definition of analytics that focuses on the creation of value, we need to consider how value is generated. Analytics generates improved business performance by both decision-advantage and execution-advantage.

Decision advantage comes from using explicit decision models to frame, deliberate, and make decisions. Explicit models and visible decision cycles make it possible for people to collaborate because everyone can see the decision emerging and changing based on the criteria, weightages, scenarios, and options under discussion. An explicit decision model is also an external entity, existing outside the mind of any one person, and so less subject to individual emotions and biases. Group biases can be managed using decision processes that control for factors such as groupthink, group radicalizations, etc. In many cases the explicit decision models are data-driven, hence grounded in facts. In other cases, especially those encountered in game theory, it can be sufficient to use heuristics to guide the decision process.

Execution advantage stems from the ability to monitor and manage the execution of decisions, using the decision models and extending them to check the values of the internal and environment variables. It enables managers to drive adoption of the decisions, and also to continually check how the adoption is affecting the expected outcomes. These outcomes are to be traced to the creation of business value, directly or indirectly. Thus, the execution advantage becomes an "actuator" for the decision advantage, by connecting decisions to value creation.

Because of the implicit or background nature of the advantages conferred by analytics, it is difficult to separate the analytics effect from the confounding effects of chance – chance in the business environment, in each process performance, and in the application of talent. Difficult, but feasible: INFORMS, for instance, is a professional body that holds the annual Franz Edelman competition to showcase the impact of advanced analytics. The Edelman Award is only conferred by INFORMS after rigorous academic scrutiny and is won by teams that demonstrate huge value (in the billions of US dollars) created by the application of analytics and acknowledged as such by key leaders of the organization. After the competition, the INFORMS journal "Interfaces" publishes papers describing the Edelman finalists.

The experience of people involved in analytics is, however, a mixed bag: in many cases projects fail. In an industry survey on barriers to analytics, “No clear ROI” claimed 30% of the responses, in addition to several other challenges (Henschen, 2012). A similar survey a year later found 36% responses for “No clear ROI” – it’s getting worse (Henschen, 2013). In a similar vein, Gartner research stated that “between 70% to 80% of corporate business intelligence projects fail (Goodwin, 2011)”, and goes on to suggest that there is a communication gap between business and IT that is to blame for it. A survey on AI/ML projects finds “78% of AI/ML projects stall at some stage before deployment” (Dimensional Research, 2019). This is not a surprise: Gartner had earlier declared that “information generated by BI systems and other decision inputs are rarely linked to business decisions and outcomes (Sallam & Schlegel, 2009)”.

Analytics deliverables are provided to decision makers, but only rarely does the analytics process extend to providing the decision support that is needed to enable the adoption of analytics to make decisions, drive execution, and assess results. This gap is exemplified by the lack of decision inventories, something you would expect to find in organizations that aim to provide decision support.

To ensure that analytics efforts and investments result in the desired outcomes, leaders must think about the demand, the supply, and how to relate investments in analytics capabilities to the benefits. To do so, they must examine the decision cycle. Do we provide decision-makers with the analytics they need for their decisions? After the delivery of analytics to the decision-makers, do people adopt the recommendations? After the decision is made, is it executed? If executed, does it lead to the expected results?

The decision cycle serves as the bridge that enables communication and collaboration between business, IT, and analytics organizations. This requires you to:

- Use explicit decision models. These models must connect to the organization’s business decision inventory, contain the rules needed to assess relevance and validity, and can include algorithms for forecasting, optimization, simulation, visualization, etc. Explicit decision models can also be double-checked by other professionals. Your organization has to be able to continually create, evolve, and assess its decision models.
- Bridge the gaps from analytics deliverable to decisions, and from decisions to execution. For this you need to understand the domain of biases and leverage the body of research on motivation and incentives. The danger of blind devotion to “quant” oriented analytics is that many people seem to forget the lessons learned by previous generations while applying “scientific management”, “management by objectives”, and other quantitative techniques. Leaders need to have an understanding of inherent limits to individual rationality and the huge complexity of the real world and use it to guide the selection of the most useful decision-support techniques.
- Foster a culture of analytics – also known as constant rationality. This is done by developing a culture of learning by experimentation and treating each decision model as an experiment for improving the business. In such a culture, accountability gets tied to the decision model and can be managed with lesser messiness than when accountability only ties to a person or team. Such rationality places a larger demand on leaders and adds a new word to the list of leadership characteristics. Leaders must practice rational decision-making and openly drive learning loops from failures as well as from successes.

Managing the decision inventory as a business asset

Consider this: if your decision cycle is a source of competitive advantage, then it needs to be tracked and managed as a business asset: the analytics asset. In many cases at present, the decision cycle is tracked as follows:

- Decision models (analytics specifications) are stored as requirement, design, or policy documents, supported by a requirements management process.
- Analytics deliverables are created in various ways: as documents (e.g., spreadsheets, presentations, or reports), as data-sets available online through dashboards and visualizations, etc. It is difficult to find a single consistent way to store deliverables.
- Decision making logs may be maintained as minutes or in email trails, or not available.
- Decision execution records, similarly, are dispersed in various communication system or not available.
- Results may be gathered systematically and constitute an analytics “deliverable”, or be assessed on request (as an ad-hoc deliverable), or left unmonitored.
- The decision inventory, when it exists, may be found stored as a document.

Mature organizations that rely on math models (e.g., banks and insurance providers who use fraud detection models, or manufacturers that use inventory forecasting and factory planning models, etc.) have processes to manage the models. The Data Mining Group has published a Predictive Model Markup Language (PMML) format to specify predictive models. The Object Management Group has published a Decision Model and Notation (DMN) for specifying repeatable decisions. Systems and processes exist to manage models in the context of a control group, to track the performance of models, to flag models due for re-certification, etc. This enables and supports test-and-learn processes that compare models versus the incumbent champion or best model. These systems and processes used to manage decision models need to be scaled to manage the decision cycle for the enterprise.

Decision models enable visibility of the entire decision cycle, and are manageable as metadata embellished with pointers to data such as deliverables, decision logs, decision execution observations, and results. Decision models can also be chained, to address cases where a decision also serves as an input to other decision models (e.g., an employee headcount report can be used to manage real-estate locations or a customer attrition control decision can factor into a decision for launching customer retention campaigns).

Creating a store for decision cycles, a decision inventory, enables you to manage them as business assets. It has the data, metadata, rules, algorithms, deliverables, their creation, usage and outcomes for all the analytics used in the organization.

Analyzing the decision cycle enables leaders to see where analytics is being created and used, and to track the resulting business value.

The first benefit of creating this asset is that you can visualize and monitor the use of analytics in the organization. You can detect best practices, gaps (blind spots) and overlaps, and process breaks. The detection of gaps and breaks drives adoption of analytics in the business, and overlaps illuminate opportunities for improvement.

The next benefit is that you can assess the value generated by the analytics, and use it to establish a culture of experimentation to continually improve the value. As the analytics asset enables the continual generation and improvement of business value, we can say that it confers a competitive advantage.

Managing variety

The creation of a viable competitive advantage from analytics requires that you wrestle with three kinds of variety:

- The variety of data issues and errors embedded in the data that you ingest into your analytics,
- The variety of insights that people generate, using a range of skills and techniques, and
- The variety of business contexts in which the insights are used to make and execute decisions.

Faced with such variety, some professionals prescribe standardization, some leaders fall for the “single source of truth” dogma, and others just tolerate the chaos because of the nuggets of value that periodically surface from the churn. For it is a churn – analytics has to provide a way to navigate the turbulent waters of business, and so analytics models must reflect it. The challenge is to create an understandable view to enable effective navigation.

First let us address the dead-end paths, so we can avoid them.

Standardization, or the fallacy of perfect design. This path starts with a big effort to fully understand the business. The project team is exhorted to model the business perfectly, for now and for the future: to be omniscient, all-understanding, and prophetic. This grand model is built, reviewed, and implemented as the “standard model” upon which all business decisions must run. The good ones yield some benefit in selected business areas, and all of them cede areas where the model is insufficient and people either ignore or home-brew their analytics.

The “single source of truth” dogma may avoid the grand design but asserts that one brand of analytics must be used by everyone. This is useful to avoid the paralysis caused by dueling analysts and draws its strength from the pragmatic notion that defective analytics must be avoided. Along that path, sadly, lies the notion of infallibility – a human weakness that leads towards making the single sources of truth itself defective. To complicate matters is the notion of “known defects” in the analytics deliverable, which establishes the concept that the slightly defective source-of-truth is good enough for the business purpose it serves ... and often that purpose is not clearly bounded. To avoid this infection of defects, it is always important to continually assure that what you regarded as true remains usably true for the purpose of its use.

Tolerating the chaos has the benefit of low expectations, and the downside of sub-par results because the organization detects the toleration and interprets it as a lack of commitment or belief in using analytics. Heroic efforts or “diving catches” are seen, but it’s a lot harder to create heroic one-off value from analytics because it generally demands steely determination in driving execution. Such determination is usually not correlated with chaos-tolerating hands-off policies.

The path forward comes from aligning the decision model to the business scenario. The decision models for the scenario determine the purpose and point to the value. Feed the best insights into the scenario, and assure data quality to the level demanded by the scenario. This becomes the analytics asset, a nugget of potential value. The method to create the asset reverses the issues of the dead-end paths:

Commit to building the decision model from the base of the current situation, even if it is chaotic. This demands the leadership commitment to transition from inconsistent decision-making habits to consistent decision-making informed by analytics. Put this commitment to the test in selected scenarios, each of which creates an analytics asset that has potential value. Use it to realize the value and drive forward on the successes. Leaders need to be able to understand the concepts of risk and uncertainty, and use analytics to improve their navigation, e.g., by improving the win-rate for opportunities – it can't be 100% but it can get better with analytics.

Understand that “all models are wrong, but some are useful”, and use it to find and monetize additional opportunities for analytics while avoiding any pretense of infallibility by continually checking. Check the business scenario – has anything changed that will demand that the analytics model changes? Check the data for issues and re-validate the models. Proactively quarantine infected models to avoid mixing good models with bad ones. Assure that the analytics assets in use are fit for the purpose of their use.

Allow the enterprise design to emerge as a visualization of the decision cycle. Welcome home-brew analytics and add them to the picture, make it easy for value to be recognized, incorporated into the enterprise asset, monitored and monetized. An emergent design will reflect chaos, upon which a “navigation” design can be overlaid, much as a map-grid and route-maps can overlay a topographical map. This enables leaders to chart their paths while recognizing the rivers and ridges in their way. It provides the benefit of informing strategic deliberations with the well-founded realities embodied in the decision cycle.

The path to analytics requires you to navigate the requisite variety posed by the business environment with determination and care. It does not place superhuman demands on you.

The analytics system and analytics stages

A decision inventory will show that decisions in the organization are at different stages in the way they use analytics. The key architectural issue facing IT is to provide the systems needed to support analytics at all stages. Due to the pressures of managing variety, there will be a proliferation of decisions (scenarios), data, and decision models (insights). Current systems are designed with layers of functionality that work in concert to provide data and visualizations that can be used in many ways by various people across the enterprise. This architecture must be extended to handle the growth of variety.

To accommodate the findings of the inventory, we'll need to add a “Stage 0” to the previous three stages of analytics to account for unserved decisions. Each stage places a different demand for systems support. Stage 1 is the most widely used, and systems that support it include the familiar reports, dashboards, online analytical processing (OLAP), data marts, data warehouses, and relational database management systems (RDBMS).

Stage 0 is commonly encountered by analytics teams when they start on a new project, and people either “whip up” their own little sandbox to play in or use an IT-supported sandbox environment. With the advent of Hadoop, that supports the schema-on-read model versus traditional RDBMS that require schema-on-write, it has become easier to build and scale these exploration-oriented systems (Awadallah, 2013). Stage 2 systems manage math models (such as regression, linear programming, clustering, etc.) in conjunction with the data-management and reporting functionality brought over from Stage 1.

Stage 3 systems support the decision cycle. They need to support a decision inventory, and then manage the lifecycle of decision models from specification to adoption and results. As a design principle, each decision model is independent of others, as each needs to evolve independently. This is because there will be many models, and they can be quite short-lived – e.g., when they are superseded by a better model by operation of test-and-learn processes.

Stage 1 systems cannot support Stage 3. Let’s explore this concept using data marts, a viable and valuable design for Stage 1 analytics. The data mart generally serves a set of business scenarios, and thus implicitly embodies several decision models. Specific outputs (reports, alerts, etc.) can be tweaked and created to further refine and differentiate the scenarios that the data mart supports. As it is one design that serves multiple implicit models, its developers fuse the requirements of all the models into the data mart design, and generally layer the designs (e.g., ETL, database schema, data quality, etc.) for subsequent development, operations, and maintenance. After such mashing and re-slicing it becomes difficult to trace-back the code to the decision models. The knowledge embedded in the data mart layers does not help you to monitor and manage decision cycles.

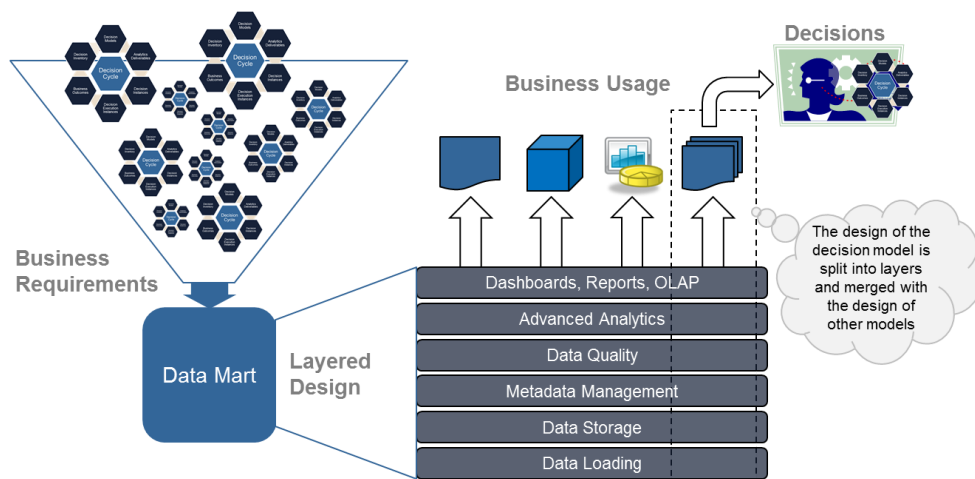


Figure 3: Layered design of data marts
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Data marts and data warehouses can be assessed and indexed to become nodes in Stage 3 decision cycle support systems, especially as sources of clean data. A diligent metadata-maker may even describe their various features and functions. In this way, these Stage 1 systems can continue to serve their data provisioning functions for the decision cycle.

Making the decision cycle an asset

When you set out to create the analytics asset for your organization, you will need to align the stakeholders to assure the success of the initiative. In the case of analytics, you will find:

- Business people will need to buy-in to a future state where explicit decision models support the organization's decision inventory. Very few would have familiarity with decision models. Once they understand the concept, they can jump forward to working out the implications: the recommendations from the decision models may not align to the current incentives, siloes, information flows, processes and decision-rights. An audit of these aspects will reveal misalignments, which serve as opportunities for improving the organization from a decision effectiveness perspective. Research conducted by Bain found a tight link between performance and decisions, and they recommend aligning the organization structure and incentives around decisions (Blenko, Mankins & Rogers, 2010). Business will also need to buy-in to the new mindset of using analytical models for making decisions in addition to the usual inventory of decision-making methods that include committees, separation of duties, etc.
- IT will find a gap between their current BI and DW infrastructure and the needs of supporting the analytics asset. The decision inventory will reveal gaps that will require new data sources, as well as overlaps where the current infrastructure is overbuilt. They will find new "white spaces" of functionality that their selected tools do not support. Some of these gaps and overlaps may be viewed as criticism of recent and ongoing project expenditures. All this will generally take place against cost pressures and existing demands for improving data quality, scaling the analytics infrastructure, integrating tools and phasing out obsolete systems. After they understand the new IT requirements for analytics, they will need to figure out how to migrate to it.
- Analytics professionals find that they now need to think beyond the techniques they use for analysis, and either develop decision modeling skills or learn how to work with decision modelers. The organization will need to train or hire people to become decision coaches (Barrager, 2012) or advisors, who will build the decision inventory, develop decision-making processes, enable the adoption of decision models, assess decision execution and track business value. They will need to move out of the comfort zone of serving known business scenarios with tested techniques and standard data supplied by IT, and venture out into the wilds of developing decision models that address new business needs and encounter unforeseen data issues. The organization's culture may not insulate them from the downside of conducting failed experiments. The new analytics asset will reveal the deliverables that have limited use and uncertain value, and they may worry about needing to defend themselves against this information. All this, while they struggle with their operational responsibility of assuring the applicability, quality and trustworthiness of their analytics deliverables.

As usual you will also encounter the weight of experience that anchors the status quo: you will contend with the scars of previous encounters with flawed analytics, organizational resistance to new ideas, punishment for failed experiments, etc. The good thing is that people have already started to call for "actionable analytics", and they perceive the need to get more adoption/usage of analytics (Twentyman, 2012).

Where would you start? By finding where the business need exists – in the business scenarios. Locate the target scenarios by building a decision inventory. For this you will need to use a model of the enterprise. To get started you can use your current business processes models, your current stock of analytics deliverables, as well as external reference models such as the Process Classification Frameworks published by American Productivity and Quality Center (APQC), eTOM published by TM Forum for the telecom industry, or other applicable models. Use these as optional inputs towards building the decision inventory for your organization, one that reflects your specific strategy, structure, systems, and situation.

Next, compare the decision inventory to your business needs and current stock of analytics deliverables. You could also benchmark your peers or outside your industry. Select targets for which you will build decision models, possibly for being high-impact, or low-hanging fruit (easy to “pick off” and show value), or that provide a good “learning laboratory” in which to pilot your new analytics methods. The selection methods used are like those used in other portfolio selection/prioritization scenarios. After selecting your targets, loop around the decision cycle to get to the business outcomes that you can use to measure and guide your progress. Continue looping to start benefiting from the learning curve, and scale to other decision needs.

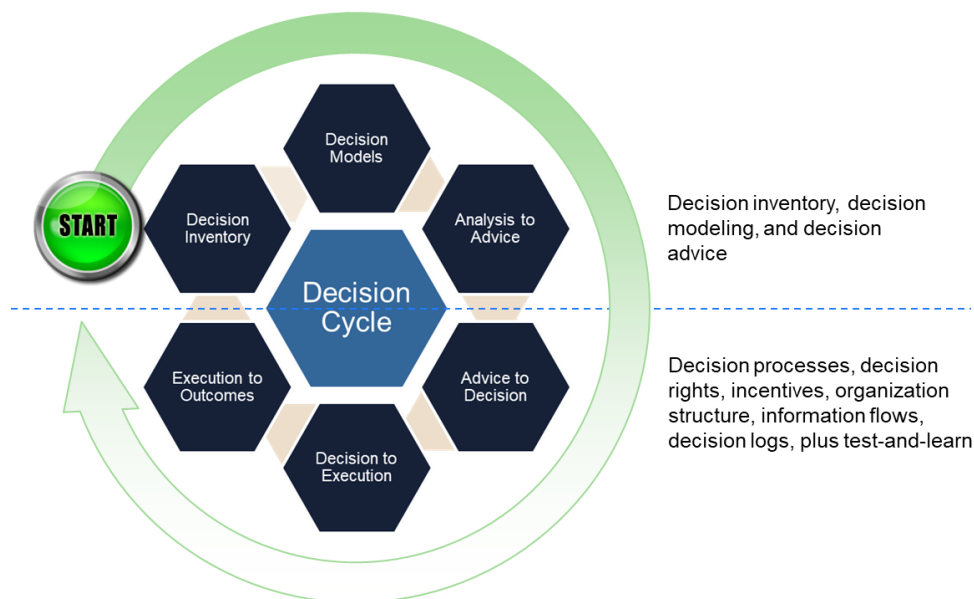


Figure 4: Decision inventory to outcomes
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Decision models with proven value are assets, and these assets must be supported with a decision cycle system. In this way IT is provided with analytics use-cases that they can use to start the migration to the analytics systems.

The Analytics Transformation

The culture of analytics creates a learning loop, as you learn from the outcomes of each decision cycle. It starts with the creation of the decision inventory, which you can use to direct efforts, monitor progress, and assess results. The ability to monitor and manage a decision cycle must be coupled with an ongoing commitment to drive learning by experimentation. The subjects of experiment are the decision algorithms, so that results get

tied to algorithms instead of people and teams. Instead of the sole responsibility for decision quality resting on decision-makers, the use and evolution of decision processes and decision models helps to improve decision quality driven by the adoption of Analytics. It's not easy to create and sustain your organization culture to use analytics. Instead of decision by position, the culture would demand decision by objective rationale. The benefits are attractive: less waste, better results. The path is thorny:

Data Supply Chain. When you set out to build your analytics capability, you must feed data to it on an ongoing basis. Here you discover that your systems providers aren't used to sharing data. Setting up and operating the data supply chain is not just about the new capability staffing, methods, and technology. It's also about ensuring that it works smoothly with data providers.

Data Stewardship. After data arrives and analyses start, data issues will surface because of the unexpected ways in which the source systems are configured or used. Backdated records, incorrect journal entries, and other issues will appear. You'll need a data stewardship capability for ongoing monitoring and control of data quality, to institute a culture of data accuracy and to ensure that data quality is maintained. Cyberattacks and data thefts can target the analytics system to steal data, disrupt data flows, or insidiously subvert data quality.

Data Analyses. Reports from your new Analytics capability will show variances in metrics against your current reports. Even when they're supposedly driven from the same data, you'll find yourself face to face with the truism that all management metrics get doctored over time ... and the fact that your subordinate may have a better view of the metric. The differences can be unsettling, and tempers can flare. Calmly navigate to the best practice, either as a change to the report algorithm or as a change to how the organization defines the metric.

Decision Modeling. Converting "expertise" or "tribal knowledge" into specific decision algorithms is unnatural for non-algorithmic thinkers. The process is fraught with error and miscommunication. People may not like their hard-won experience being converted into a simple statistical rule. Optimization experts may not understand the need for incremental moves to the optimal. An understanding of control systems will lend an appreciation for damped responses as opposed to overshoot, to calibrate responsiveness versus oscillation. Reducing decision hand-offs must be traded-off against having checks and balances. Biases and misinformation may get embedded inside decision algorithms and require special efforts to locate and remove.

Decision Support. Analysis will shine an uncomfortable light on the accepted practices in your organization's decision making. Adopt "truth and reconciliation", grant amnesty for past issues and patient support for improvement. Train people to start using decision algorithms. Align incentives towards systematic use of decision cycles. Locate, communicate, and celebrate successes.

Opportunities to Results. The volume of opportunities to change revealed by building and analyzing the decision inventory can feel overwhelming. You'll find unserved needs, partial coverage, ineffective decision models, multiple competing decision models, unused decision

models, etc. Create a roadmap and solve it. Build the capability to manage with Analytics in each selected area so that over time the entire organization can react smoothly to Analytics signals. This is the creation of organizational agility and that depends on each area getting out from managing by inertia to continuous improvement. Analytics is sure to give your leadership a workout.

Conclusion

Analytics enables businesses to navigate rationally from idea to execution. With analytics you find better ideas, analyze them effectively, take better decisions, and execute faster. Business has always been complex – analytics provides a way to illuminate it, select a path, and navigate the complexity. The usage of analytics should, therefore, be supported by leaders – you must evaluate your analytics capability and start to build the analytics asset.

A Jamalpur alumnus, Rahul Saxena is the CEO of CoBot Systems. He has been focused on operations & analytics since 2004: first in a startup, Epiance, and then for McAfee and Cisco from 2006 to 2013. During this time, he has developed Analytics Centers of Excellence, filed for a patent, presented at a key international conference on analytics, assisted with the creation of a professional body and certification for analytics, and written a book on analytics.

He has co-authored a book, "Business Analytics: A Practitioner's Guide", published by Springer in its International Series in Operations Research & Management Science. This book provides a guide to businesses on how to use analytics, Operations Research & Management Science to improve decision effectiveness. The Analytics Asset by Rahul Saxena & Ranjita Gupta is due to be published as a chapter in the book: "Global Business Leadership Development for the Fourth Industrial Revolution", projected release in September, 2020. The author has generously permitted Cogito to publish this article ahead of its international publication with hope that the article would provoke discussion on the urgency of analytics in IR. He will be happy to answer questions on the subject. Doubts and questions are welcome at editor.irifm@gmail.com.



Impact of evolution of Electricity Act, 2003 on Indian Railways

K. Sitharamaraju

Indian Railways spent nearly Rs 35,000 crore towards fuel charges for traction and non-traction purposes in the year 2018-19. This expenditure is barely short of 20% of the total revenue expenditure of Indian Railways. The largest part of this expenditure was incurred in buying 274.9 crore litres of high speed diesel (almost Rs 20,000 crore). On the other hand, despite a much higher percentage of NTKM and PKM in the total transport statistics being carried under electric traction, electricity expenditure in the same period is Rs 15,000 crore with consumption of 1768.1 crore kWh. In this article, an effort has been made to analyse the broad trends in the electricity sector over the past decade and discuss a few ways through which Indian Railways may benefit from the opportunities reflected in the trends.

The cost of electric traction is far economical vis-a-vis diesel traction. As per the specific fuel consumption and specific energy consumption figures of Railway year book 2018-19, electric traction for passenger services is about 35% cheaper vis-a-vis diesel traction. In case of goods trains, if we consider 1000 GTKM, transportation under electric traction would cost about 60% less than under diesel traction.

	Description	Units	Units per 1000 GTKM	Unit Rate	Total Cost
1	Passenger Service – Diesel	Litres	3.74	70	261.8
2	Passenger Service – Electricity	kWh	18.9	9	170.1
3	Goods Service – Diesel	Litres	1.97	70	137.9
4	Goods Service – Electricity	kWh	5.89	9	53.01

In this illustration, the highest rate that is being charged for kVAh is taken as the unit rate for electricity (most Indian states have shifted to kVAh billing for railways). To put it into perspective, if we undertake electrification of all our tracks, even in the worst case scenario, IR can save about Rs 6,740 crores of revenue expenditure (assuming that the entire utilization is for passenger services alone; if we bring in a mix of passenger and freight transportation, savings can go up to about Rs. 9000 crore in the best-case scenario). Within one year of these savings, we can electrify 10,000 kilometres of track on IR.

Needless to say, we have not taken into account, the economic costs that accrue to the Indian economy in terms of the foreign exchange reserves saved, to say nothing of GHG emissions reduced due to the shift from diesel burning to electricity consumption. These advantages are the major reasons for IR's target of 10,000 route kilometres electrification in the year 2019-20. Having discussed this aspect, another pertinent question that should be asked is, are these the maximum savings that we can expect or is there any further scope for greater savings? To answer this question we need to understand the present structure and status of the electricity sector in India.

Electricity Act, 2003

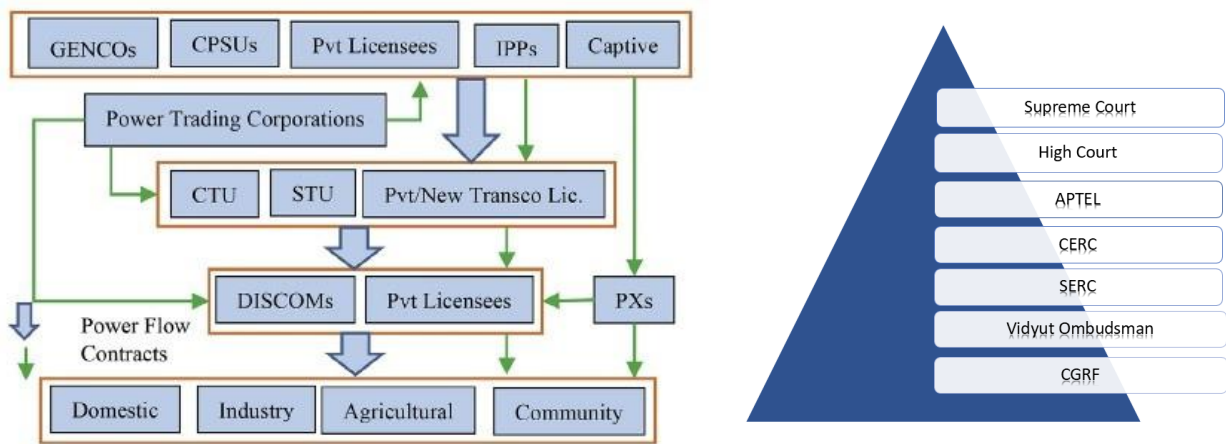
In order to bring in efficiencies in ailing the State Electricity Boards and other associate public sector utilities such as NTPC, Powergrid etc. and to bring in new technology and investments from private sector, Government of India introduced the Electricity Act, 2003.

For the sake of uninitiated, the most important provisions of this act are as follows:

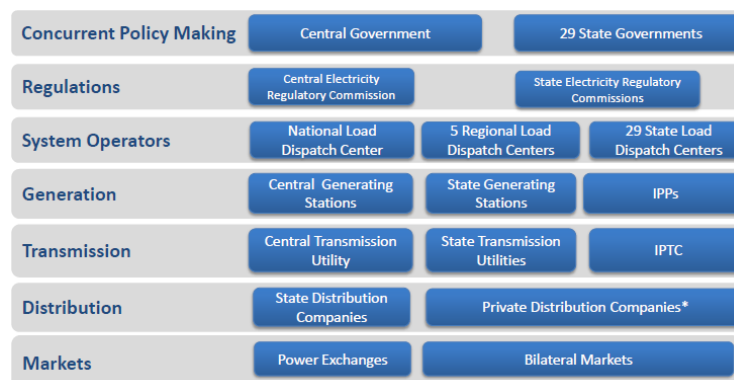
- Generation has been delicensed except for hydel power (Section 7)
- Captive generation freely permitted along with open access freedom. (Section 9)
- Licensing from appropriate commission is mandatory for all activities. (Section 12) (for trading, distribution and transmission)
- In rural areas notified by State government, license is not required for generation and distribution of electricity.

Present structure and trends in the power sector

Over the next few years, Government of India with the help of Central Electricity Authority (CEA), has amended the Act with respect to open access, trading, and settlements mechanisms to liberalize the electricity sector even further. After these amendments, the electricity sector landscape in India can be depicted succinctly as shown in this figure:



The top layer comprises power generation companies, and the second layer, transmission companies (in between lie trading corporations, power exchanges). The third layer comprises distribution companies and the bottom layer, the consumers. Dispute resolution mechanism has been depicted at different levels in the figure on the right. Over the years, with different sets of amendments, the Ministry of Power, with the help of CERC and CEA, has gone on to define power exchanges, transaction losses, transmission charges, eligibility criteria, and risk mitigation strategies for setting up power exchanges. Also, the principles of price discovery have been notified. The present framework of the Electricity sector landscape is depicted in the figure below.



Very recently, CERC has also come up with regulations on sharing of inter-state transmission charges and losses, deviation settlement mechanism and related matters, grant of connectivity to projects based on renewable sources to inter-state transmission systems, etc. Let us see the trends that have emerged in the power sector:

Trend 1: Increase in the captive generation and preference for renewables in recent times

Captive Power Statistics as on 31 March 2019				
Source	Capacity (MW)	Share (%)	Electricity generated (MU)	Share (%)
Coal	34,833	60.06	1,41,137	80.64
Hydroelectricity	48	0.08	97	0.09
Renewable energy	1,881	3.24	2,258	1.28
Natural Gas	7,753	13.37	23,785	13.58
Oil	13,485	23.25	7,723	4.41
Total	58,000	100.00	1,75,000	100.00

The impact of freeing up captive generation over the years can be seen in the graph above. We have come a long way from the days of almost non-existent captive power in 2003 to almost 58,000 MW of installed capacity (16.2% of the total installation). There is a definite shift in the preference of captive power towards renewable energy, mainly wind and solar energy. This trend is becoming increasingly visible in the recent years. Since getting coal and gas linkages is impacted by bureaucratic hassles, solar and wind power plants are preferred because of reduced capital costs. Increase in captive power generation is solely attributable to the delicensing of power generation and giving cost-free open access to captive generation entities. The actual electricity generated by captive plants is almost 175 billion units which is almost 14% of the total energy generation in India.

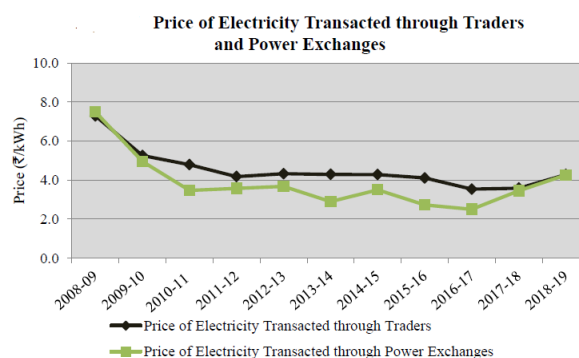
Trend 2: Emergence of power exchanges, significant increase in open access consumers, and decrease in cost of power

Provision for Power Exchanges and Trading Licenses are two significant steps taken by the CERC as part of its open access regulations. By a series of amendments in 2008, 2009 and 2010 it facilitated the setting up of power exchanges. Indian Energy Exchange is the first energy exchange in India, set up in 2008. It has given way to two significant trends in the power market. One, the number of Open Access Consumers (OAC) and volume of OAC on power exchanges is on the rise. Open access regulations have given wings to the consumers, especially power-intensive ones, who either go for captive generation or buy power on the open exchanges whenever the cost per unit given by the regular distribution company is higher than the market price. Some of the energy intensive cash rich companies like JSW steel and Tata steel have in fact entered the power generation business and started selling power on the exchange whenever they have either surplus power or the cost dynamics are favourable to them.

The cost of energy has come down significantly over the years. Merchant power plants have been set up by many industrial groups in the period 2007-2012. (Power price per kWh is depicted below). During this time, the country was facing huge energy and peak power shortages. It is evident that whoever produces electricity has adequate market opportunities.

Hence, industrial groups set up huge power plants without long term power purchase agreements.

But, setting up of power plants is a highly capital-intensive activity and requires long-term loans from banks. These merchant power plants, after completion, have to offer low prices to power exchanges. At the same time, the biggest consumers of electricity in India – distribution companies are required to only buy power from Renewable power plants as per CERC guidelines.



Most of these merchant plants are gas-based and are highly efficient as they have been set up very recently. Since there is no market, most of them are under financial stress. Having recognized these macro trends in the power sector, IR must try to capitalize on the situation.

Opportunities for Indian Railways

As per the 2018-19 Indian Railways year book, IR consumed about 17,682 million units of electricity for traction and 2,264 million units of electricity for other purposes (supply to railway stations, railway colonies, etc.). Let us see what opportunities lie ahead of IR in this regard:

Since IR is one of the largest consumers of electricity, state electricity utilities have come to think of railways as a highly dependent consumer. They have used it to their advantage by increasing the tariff for railways' electricity consumption. A simple study of different state public utilities charges towards Railways is depicted alongside.

	State	Fixed Charges (Rs/kVA/month)	Variable Charges (Rs/kVAh)
1	Uttar Pradesh	400	8.5
2	Maharashtra	391	7
3	Bihar	280	6.8
4	Punjab	230	6.87
5	Assam	300	6.45
6	Tamil Nadu	300	6.35
7	Delhi	250	6.25
8	Karnataka	220	6.2
9	Madhya Pradesh	310	5.9
10	Haryana	160	6.35
11	Jharkhand	350	5.5
12	Andhra Pradesh	350	5.5
13	Odisha	250	5.3
14	Kerala	300	5.1
15	Himachal Pradesh	400	4.7
16	Gujarat	180	5
17	Chhattisgarh	350	4.2
18	Telangana	390	4.05
19	Uttarakhand	250	4.4
20	Rajasthan	135	5.7
21	West Bengal	105	6.88

An important point to note here is that the fixed charge itself is steep and the cost of supply is far higher than average

power purchase cost. Moreover, all the utilities have gradually shifted towards kVAh billing from kWh billing thereby extracting more out of railways. Since CERC has already advised the state electricity regulators to recognize IR as a deemed distribution licensee, even though most of the states are yet to confer that status upon IR, it is essential for zonal

railways to fight for deemed licensee status at state ERC levels, which will reduce the cost of electricity significantly as IR does not need to pay fixed charges and can directly access the power exchanges without any bureaucratic delays. Zonal railways should appeal at the level of APTEL in case any state electricity regulators do not recognize it as a deemed licensee.

A lot of power projects in different stages of construction are under the watch of Insolvency and Bankruptcy code. These can be utilized as captive power plants for railways' consumption needs by buying them at cheap capital cost since a number of banks are under significant stress to monetize such power projects which form their NPAs. Additionally, railways should start procuring open access power which is far cheaper than power bought from state power utilities. Zonal railways should create special purpose cells at headquarters with a team of electrical and account officers so that quick decisions can be made for purchase of power so as to reduce the cost of the electrical power to more manageable levels.

Railways should also take part in SECI tenders as a buyer as cost per unit for renewable energy is less than Rs 2.5/kWh and State Utilities are bound to allow railways open access rights for captive consumption. This will help achieve savings for the railways.

Since most of the passenger trains are timetabled, we can predict consumption required in a particular TSS with reasonably accuracy. With increased pressure on us to timetable even goods trains, our ability to predict electricity consumption requirement can be enhanced considerably. This will open up many possibilities for savings for IR that will ease our access to power exchanges where the cost of the power is cheaper. This itself will reduce the cost of the electricity by thousands of crores of rupees every year. Western Railways (WR) has reduced its dependence on state public utilities in this way. WR's consumption from Maharashtra state electricity distribution company has come down from 1,579 million units in FY 2014-15 to 77 million units in FY 2018-19 by making accurate projections of the requirements.

Need exists to set up an Indian Railway Energy Transmission Company Limited by utilizing our right of way to construct transmission lines (underground) along the track on the lines of OFC of RAILTEL corporation. This is predicated on the threat that IR is going to lose a significant share of coal freight as the trend of the pithead thermal plant setting up has emerged in the power sector. Having a long right of way, if we are not able to transport coal on the track, it is ideal to build electricity transmission lines along the track to transmit power and thereby, secure our own future. We need to incorporate a separate entity to enter into the business of transmission. With the simple right of way alone IR can generate significant revenues. The evacuation of power from new renewable power plants is one of the biggest bottlenecks faced by the electricity sector in India. Hence, creation of such an entity will benefit both IR and the economy as a whole.

IR should quickly shift to electric traction from diesel traction. Indian Railways is facing a multitude of challenges in the times of COVID-19 where any saving is of paramount importance. The ever evolving electricity sector presents significant opportunities for savings as well as revenue generation.

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Private passenger trains in India : a reform full of challenges

Yogendra Sharma

“Allowing third party to undertake passenger train operations in Indian Railways is a historical decision. However, in the absence of an Independent Regulator, it would be challenging and in its current form, could become a high risk business.”

On April 16th, 1853, India's first passenger train hauled by three steam locomotives, set off on a 34-kilometre journey from Bori Bunder (Mumbai) to Thane. Over the next hundred and sixty-seven years, Indian Railways (IR) went through multiple operational, economic, and technological transformations. Today IR is a powerhouse with 4th largest network in the world by size, and the nation's lifeline, moving more than 23 million passengers and 3.3 million tons of freight every day. Also, IR is one of the biggest employers in the world.

With the liberalisation of economy in the early nineties, Indian Railways began taking baby steps for privatisation of various services such as catering (at the stations and on board), and conservancy services. This was followed by IRCTC allowing private investment in operation of tourist trains. In 2006, Indian Railways opened the doors to private operators for container trains. At the same time, private investment was allowed in building non-government railway lines, followed by inviting investment from state governments and public sector undertakings for expansion of railway network, including creating last mile connections through joint ventures. In 2016, IR touched another important milestone by attracting Rs 40,000 crore private investment in two high horsepower locomotive factories in Bihar for the manufacturing and maintenance of 1900 locomotives. This has been a successful model under “Make in India” and in a very short time, world class locomotives manufactured in these factories, have started operating on Indian Railways.

The beginning of privatisation of passenger trains took place in 2018, when Indian Railways allowed IRCTC to run a passenger train called Tejas on the Delhi - Lucknow route. However, year 2019-2020 shall be seen as an extraordinary time, when the Ministry of Railways have undertaken two big reforms, first being the long awaited restructuring of railways by merging all eight group A services to one Indian Railways Management Services (IRMS) and second being the issuance of “Request for Qualifications” (RFQ) for operation of private passenger trains on the national rail network. A total of 109 routes in 12 clusters have been opened, which will need 151 train sets of minimum 16 coaches per set. Government sources believe that this would be 5% of the total market of mail and express trains operating over the network. The concession period shall be for 35 years. At this stage, it is expected that private passenger trains shall start operating from April 2023. This gives two years' time to the selected parties for arranging the rolling stock and commencing operations as per their business plans.

From the standpoint of private investment, it is expected to bring Rs. 30,000 crores mainly for design, manufacture and procurement of rolling stock including passenger cars and locomotives. The new rolling stock will have to meet the IR design criteria and be equipped with on-board train operations system suitable for 160 kilometres per hour speed limit. They

are required to run up to 4,000 kilometres without any maintenance and up to 40,000 kilometres before any major repairs on the train sets.

The RFQ also says that each bidder needs to develop rolling stock maintenance facilities at the terminals for their train sets and locomotives. With multiple operators likely to share a single route, this becomes the first challenge. Since facilities are capital intensive and require highly skilled and tech savvy manpower, it would be challenging for every operator to set up an individual maintenance facility, especially when land space is a major constraint around railway terminals particularly in metro cities. The RFQ also states that railways shall provide maintenance pit lines close to the terminal and the operator needs to bring their own tools and manpower to undertake repairs for major schedules due after every 30 days of operation. How this model works, especially given that we need heavy machines and fixed infrastructure like overhead cranes for such repairs, remains to be seen. Take the case of IRCTC where for preparation of meals private catering licensees were asked to provide separate base kitchen for Shatabdi/Rajdhani types of services. What most of the parties did was that they started operations out of makeshift arrangements in unhygienic conditions, thereby compromising food safety. This was a learning for IRCTC. It then came up with the solution of creating third party operated mega base kitchens for preparation of meals and limiting catering contractors to on-board supply. It would be desirable to examine the third party operated rolling stock maintenance facilities for major repairs, along the lines of MRO facilities in the aviation sector. However, such facilities may have other challenges, such as the issue of managing the spares inventory if the trains sets are of different types.

Another issue is, when Indian Railway drivers operate private operators' locomotives on a long section, it may lead to blame games in case of any technical bottlenecks. There are other operational issues, such as malfunctioning of air-conditioning system in passenger cars, which may require troubleshooting at roadside stations where private operators do not have any backup for immediate restoration of normal services. It would be better if repairs, while on journey, are looked after by Indian Railways.

Now let us see the commercial aspect which is the second biggest challenge. As per the RFQ, qualified parties need to put bid amount in percentage of gross revenue (cost of ticket along with cost of other services, such as premium seat, linen, Wi-Fi, reading material, entertainment, catering, etc.), which shall be shared with the Indian Railways. In the RFP document for each circuit, Ministry of Railways is expected to indicate the Track Access Charges (TAC) to be paid by the operator for running passenger trains over a route, including access to the stations, provision of crew and guard, and the provision of train path on predetermined timings. In addition, operators need to pay electric usage charges for drawing power to haul the train over the electrified routes. Fixing TAC would be the key to success of this experiment and IR needs to devise a mechanism to arrive at the right TAC to recover their cost and not adopt the age-old costing model of "Fully Distributed Cost" which is heavily loaded in the favor of railways. Also, during the concession period, it would be difficult to identify the marginal cost incurred on a particular route attributable to the private passenger train operator(s).

So far, the experience of Indian Railways with haulage charges has not been good, mainly because such costs are not identifiable under the current system. Also, currently the passenger train services are subsidised with freight earnings to keep the fares low. Time will

only tell as to how private operators fix their prices to maintain optimum passenger occupancy while remaining commercially competitive and sustainable over the concession period, particularly when the passengers have the option of taking other trains, maybe before or after 60 minutes, which is not a big differential for a long distance traveller.

Needless to mention, to make this scheme successful Ministry of Railways should develop a much-needed transparent mechanism to determine TAC for private trains. If we see various models of TAC applicable to private operators used by various railway systems in the world, we notice that the network operators, such as Indian Railways, have often devised a detailed and transparent framework to determine TAC through an interactive dialogue with all the stakeholders including private operators. It would also be interesting to examine the privatisation model used by British Rail, which was an utter failure. Here the role of an Independent Rail Regulator (IRR) cannot be over-emphasised. IRRs, in addition to fixing TAC, work as arbitrators among the involved parties. It remains to be seen how industry responds to the RFQ, proceeds to the RFP stage, and finally enter the game.

The requirement to start new services by April 2023 is third challenge. Interested parties have been asked to submit their response to the RFQ by September 8, 2020 after which the Ministry of Railways will complete shortlisting within 60 days. By April 2021, successful operators are expected to be in place, which leaves only twenty-four months for completing design, obtaining various approvals for new generation rolling stock, making prototypes, and undertaking lots of trials. Only after this long-drawn process can manufacturing be started. Setting up capital-intensive manufacturing facilities for a limited quantity of broad-gauge coaches is another challenge. This may require further deliberation and the prospective bidders need to have a strategy to meet design and safety requirements of the rolling stock and at the same time keep costs under control to make commercial services sustainable in the competitive market.

The risk of exit from the market once operations commence is very high due to the capital invested. It may not be out of context to examine the case of private container train operations. In 2006, 16 private investors obtained the license for operation of container trains on payment of Rs 20 crores for limited routes, and 50 crores for Pan-India operations, for a 20-year period. What we saw in the later years is that a number of these operators could not even start the services in the first place and many who did start suffered heavy operating losses and finally shut their operations and lost the deposit. Indian Railways can't afford another such fiasco. Therefore, if privatisation of passenger trains is to succeed, we need to build mutual trust and transparency in the process and a business-like ecosystem while making commercial decisions to create a win-win situation for all, including investors and operators.

A senior railroad expert, Mr Yogendra Sharma has worked in the IRTS and in the corporate sector. He also spearheaded a mega rail project in Australia with insight on a much-regulated open access rail network. He has been MD, Kutch Railway which he successfully commissioned six months ahead of schedule while saving ten percent of the budget allocated for the project. He has also played a large role in drafting the MoR's PPP policy which led to the beginning of private investment in Indian Railways. Mr. Sharma is a true blue Indian Rail enthusiast..

Wet leasing of trains : the right financial structure for private participation

Keshav Kaplush

Indian Railways (IR) is exploring private participation in the passenger as well as freight segment. Although IR has already decided on the kind of Public Private Partnership it wants to have with private players, this article aims to discuss another alternative model, namely, 'Wet-Leasing'. This model has the potential to emerge as a formidable as well as cost-effective alternative in the near future. To understand it, we should first have a look at the present model of rolling stock procurement over IR.

Indian Railways does not own ninety percent of the rolling stock operating over IR. Locomotives and coaches running on railways' track are owned by IR's financial arm, Indian Railway Finance Corporation (IRFC). To procure the stock, IRFC borrows money from domestic and global markets, purchases the rolling stock and then leases it to IR. This is a 'financial lease' where Railways decides which rolling stock to buy and directs IRFC to buy it from Railways' Production Units (PU) and lease it back to Indian Railways. Thus, leasing in the form of 'lease-back model' is already an embedded idea in the Indian rolling stock landscape.

The financial lease model, however, is limited to the Ministry of Railways (MoR) as all three parties, the PU manufacturing the rolling stock, the procurer, and the financier, belong to same promoter, namely, the MoR. The idea of Wet Leasing of trains is an improvisation over the existing model and is aimed at increasing private participation in different segments of the railway sector. Wet Leasing means that the 'New Leasing Entity' would not only lease the rolling stock to IR but also be responsible for repair, maintenance and overhauling of the rolling stock, and perhaps in future, also for the crew operating the trains. Thus, it is a structural shift from the 'financial lease model' to 'operating lease model' and can have tangible benefits in the railway sector some of which are:

Encouraging private players in train operations

Currently, the private players are required to bring with them a high initial investment as they need to buy rolling stock and also invest in ground infrastructure for maintenance of the rolling stock. The corollary to such high initial investment is that private players will require a considerably long concession period. However, in a competitive industry like transportation, the likelihood of failure is equal to that of success, if not more. Wet Leasing provides an alternative to the above asset-heavy structure and hugely decreases the financial liability of the private players. Thus, it encourages them to comfortably enter and exit the railway market without worrying too much about the initial investment and its subsequent financing costs. For example, if a private train operator decides to operate on 10 routes, it will require him a minimum of 20 train sets considering a daily up-down movement with journey time of more than 12 hours. To quote an example, the cost of a 'Vande Bharat' train-set is around Rs 100 crores. A private train operator may need to make an upfront investment of Rs 2000 crores on rolling stock alone. On the other hand, if he takes it on lease, it may cost him only Rs 5 crore as the basic cost of each train-set keeping the codal life of rolling stock as a conservative twenty years. Considering risk free rate of 5 percent and a margin of 20 percent as an additional cost, the total cost now comes to Rs 6.25 crore per train-set per year against the upfront investment of Rs 100 crore per train-set apart

from Rs 5 crore interest every year. So, if an operator plans to try the railway sector for five years, he can do it by an initial investment of Rs $6.25 \times 20 \times 5$ i.e. Rs 625 crore reducing his initial commitment by two-third; and if he attempts to exit the sector, he can easily exit without going for distress sale of assets.

Up-gradation of rolling stock

A new leasing entity relatively independent of the Ministry of Railways would be able to scout for good quality rolling stock and bring them into the Indian railway sector. It will encourage Indian private rolling stock producers like Medha, BEML, etc. to create good quality rolling stock and sell it to this leasing entity. This will give a new market to rolling stock producers who not only can sell train directly to private train operators but also to the leasing Company. Thus, it will become a market maker for high quality Indian rolling stock and will bring competition into this market hitherto dominated by Indian railways' production units.

Reduce cost of rolling stock

The creation of an Independent Entity will create market data for the standard cost of rolling stock and will put an active pressure on the Railway production units to become cost competitive and deliver better quality. This will benefit Indian railways who depend solely on these Production units for the rolling stock. The reduction in cost is likely to create breathing space for the railways struggling with financial woes. It will also decrease the overall cost of transportation in both passenger and freight segment.

Attracting global investors and development banks

World bank has been an active promoter of leasing in developing countries. Its financial arm IFC (International Financial Corporation) can be roped in to invest in the new leasing entity. This will not only bring low cost investment to the new entity but will also bring technical and financial expertise to Indian rolling stock market. It will also attract other development funds and banks to invest in the entity as it increases the market depth as well as creates new opportunities in transportation sector. Further, railway transportation is green and efficient and thus, fits in with the vision of global institutions looking at sustainable development, especially in developing countries.

Decreasing the logistics costs

India has one of the highest logistic costs in the world which is around fourteen percent of the value of the goods whereas most of the developed economies have logistics cost of around 8 to 10 percent of the value of goods. The higher logistics cost in India is primarily because the inefficiencies of primitive structures get passed on to the customers. Leasing of freight rolling stock will not only reduce this transaction cost but also bring in light weight rolling stock to the Indian market which is likely to be more fuel efficient. This is relevant as the dedicated freight corridor will become operational in a few years whereby a huge demand for freight rolling stock will be create .

Corporate capital structure

Unlike government institutions, a leasing entity can create a much more efficient capital structure as not only does it have the capacity to attract high quality equity investment but also the flexibility to go to capital markets and raise capital in the form which it finds most suitable to the requirement. Thus, its access to markets will make it a value creator in the sector. Further, it may come to play the role of a financial intermediary in the sector and can attract various Infrastructure Investment Trusts and Sovereign Wealth Funds.

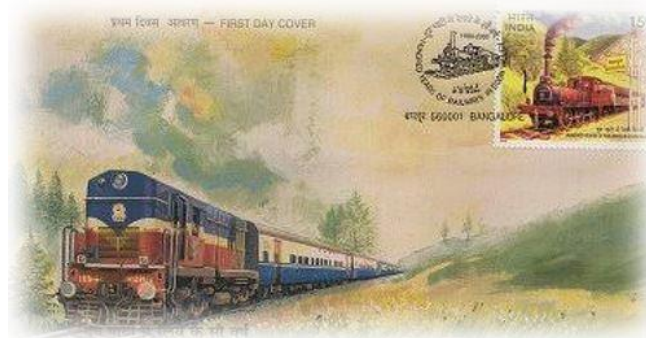
Capturing South Asian and African markets

The new Entity will lease not only to the Indian market but also to neighbouring markets like Bangladesh and Sri Lanka. IR's key Pus, RCF and ICF, already have a market in South Asia and Africa. This means that technologically the Indian rolling stock is suited to the railway infrastructure in these countries. The New leasing entity can leverage on this potential and increase the market for Indian rolling stock by providing a flexible financial structure to these countries. This can also give push to India's rail diplomacy.

If all is well then what is the risk? The major risk that the leasing entity will take on is Ownership Risk, i.e. what if no one takes rolling stock on lease from it! The answer to this question is that the market for rolling stock is always there in the form of Indian Railways. The alternative model is only attempting to create a leasing market to facilitate entry for private players. Leasing, like any other industry, will take time to mature and it will be clear whether the model is successful or not in a time frame of five years. Yes, the mistakes made by IL&FS must not be made, good governance standards must be observed, and the leasing entity must limit its functions to leasing only rather than foraying into infrastructure development.

In the light of the above, it is time to look at Wet Leasing as a suitable financial inter-mediation option. The beauty of this model is that it is achievable in a short span of time and has the potential to create an entity with professional and independent expertise. Its global governance structure will bring huge benefits to the railway sector in India which, for far too long, has been influenced by a monolithic entity known as Indian Railways. If the current government's policy goal of Atmanirbhar Bharat is to be realised, it is time to give private players (Rolling stock producers and train operators) a fair opportunity to enter into the rail market. Wet Leasing is a major component of this policy goal.

Keshav Kaplush is a 2013 batch IRAS officer. An NTSE scholar, a graduate in Computer Science from NSIT, Delhi, Keshav worked with the Royal Bank of Scotland before joining Indian Railways. Currently working as deputy financial advisor and chief accounts officer at South Central Railway headquarters, he manages to find time after hours for CFA exams, for keeping a diverse blog, and for numerous phone calls from IRIFM which he handles patiently and generously, all the while helping his wife look after their infant son.



Freight coefficient of Delhi division : a template for boosting railway revenues

Amartya Banerjee
Ashok Kumar Meena

The freight segment is often considered to be the bread and butter (67% of revenue) of the Indian Railways. Hence, it's no surprise that it demands our due attention in order to boost revenue. This paper is an attempt to present a strategy for the same through a research on 'The Freight Coefficient of a Railway Division (example Delhi)'.

Objective of the study

As of now railway collects only commodity specific data and thus, the holistic picture of a freight potential of a division is found wanting. However, this study is an effort to understand the business potential of the catchment area of a Railway unit, in this case – a division. Delhi division caters to the transportation needs of NCR region but in order to make this study simpler and more objective we have contained our focus on only the following 8 districts, as most of the freight is generated from these places. These are Delhi, Gurugram, Faridabad, Palwal, Ghaziabad, Noida, Rewari, Meerut.

Significance of the study

Transportation business is undergoing rapid and seismic changes. Its near universally acknowledged that Indian Railways needs to shift its focus from being merely a bulk carrier to the non-bulk segment. In the non-bulk commodity sector, roadways have emerged as a preferred mode of transportation despite its greater cost and environmental effects. To compete with them, we must reinvent and transform our “transportation only” orientation into the “logistics service” provider mindset. This study would be the starting point to realize this goal. Micro level studies like these are not undertaken leading to a knowledge gap about the business scope of Divisional proportions. It's quite understandable that each division caters to a particular area with its own unique economic activities. With the understanding of this potential, it will be easy for Railway administrations of Divisions to take better steps to tap into this and tailor their commercial policies to suit such needs. The recent step to constitute a Business Development Committee is a step in this regard. However, this can only be considered as the climactic end of a process. This is because bereft of an adequate understanding of the business potential as revealed by studies of the like attempted here; the whole effort will be an exercise in futility. It would be akin to going into a boxing bout without adequate conditioning. This aspect is vital for development of business outreach of Railways, boosting of revenues and emergence of each division as an autonomous profit center as envisioned by the Debroy Committee Report of 2015.

Methodology

Area of Study- major industrial areas which comes under Delhi division jurisdiction were selected. Those areas where demand for freight transportation is not significant were filtered out to keep this study manageable and simple. The focus was narrowed down to eight districts in NCR as all industrial clusters in NCR fall under these districts

Selection of sample size- To make the sample representative of all industries present in NCR it was decided to employ stratified random sampling where the selection of industry in the sample is decided on the basis of three criteria:

- Size of company- To keep representatives from small, medium and larger industrial units.
- Geographical location of the company
- Selection based upon industrial segmentation present in NCR (automobile, textile, general engineering, cement, food grains, fertilizer etc.)

Data collection method- Two methods have been employed, telephonic survey, and google form survey. Survey questions were so designed to obtain reliable, valid and objective data for the study. As an example annual loading, customer base of the company (local or pan India level), what is the average distance over which one transports their goods etc. Baseline data of Divisional loading was collected from the office of Snr DCM.

The result of the study revealed that while the total freight capacity of the NCR regions stands at approximately 64.75 million tons, Delhi Division carried 17.65 million tons in the last year (2019-20). It is also worth mentioning that the commodity mix of both tables are quite dissimilar, a poignant reminder of the incongruence of our business strategy as compared to present day realities.

Freight coefficient of NCR	
Industry	Freight capacity (in million tonnes)
Cement	15.6
Fertilizers	3.2
Automobiles	10.7
Auto Components	1.25
Textiles	12
Food grains	7
POL	15
Total	64.75

Loading Data of Delhi Division		
Commodities	April 2018 - March 2019	April 2019 - March 2020
Food grains	5.46	3.43
POL	4.75	4.92
Fertilisers	0.57	0.53
Containers	6.23	7.03
Others	1.46	1.24
Total	18.47	17.65

It would be prudent here to acknowledge the fact that lack of responses from Industries like rubber and chemical sector and Meerut Sports Goods cluster will impart some subjectivity in this study. So any inference from the result of this study should take these shortcomings into account. In order to ensure that any future study on these lines has lesser subjectivity, the sample size needs to be bigger. In case of this study, initially, a sample space of 250 was taken, which was then whittled down to 50 to keep it representative of the various parameters such as size, nature, geographic locations, etc.

Replicating the study Pan-Railways

There can be a dedicated cross departmental team to conduct the study. They can collect industrial data from District Industrial centers of the area or take help from the Commerce and Industries Directorate of the concerned State. The local chamber of commerce or industrial body can also be contacted for this purpose too.

Armed with the data, they can select a representative sample of industries taking into account their size, commodities and business model. The sample should be large enough to permit statistical analysis later on. This should lead to the formation of a set of questions which would serve as the research tool. There can also be a Google form of the questionnaire which can easily be send via Email/ Social media to elicit responses.

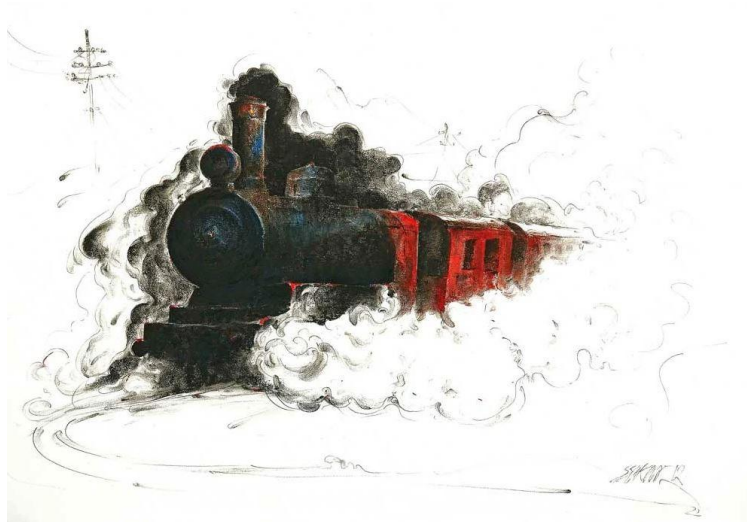
Once the sample is decided, data collection can take place either by telephonic or in person

interviews, Google form as the case maybe. Once the data is collected, they can be analyzed with special reference to industrial trends, demands and specific local factors. This will lead to the emergence of business areas which need special focus and attention. This data can then be made available to the Business Development team of the Zonal or Divisional Railways.

Boosting Freight Coefficient

The study clearly indicates that Delhi Division is missing out on business opportunities in textiles and automobile components. In case of other divisions, it maybe fly ash in case there are many power plants in the vicinity. There are many suggestions that have been given previously by committees and reports (India Transport Report 2014, NCAER Study commissioned by Railway Board etc.). None of them shall bear fruit till a thorough market research (by means of the aforementioned study) backed up by on ground initiatives are undertaken. In conclusion the proposed Business Development is actually the superstructure, while the study is the bedrock. As the maxim goes, the building is only as strong as its foundations. For Indian Railways, this study, replicated properly can lay the foundation for a strong, sustainable source of revenue for a long time to come.

The writers are IRAS officers of 2016 batch. Amartya Banerjee is currently working as assistant financial advisor in Northern Railway headquarters. Ashok Kumar Meena works as assistant divisional financial manager in Ajmer division.



Indian Railways need a growth strategy

Chander Mohan Jindal

Indian Railways' traffic index with its base 100 starting from 1950-51 has gone up to 1675 for passenger traffic and 1685 for freight traffic in the year 2018-19. Ironically, IR's share of transport has declined from 85% to 13% in the passenger segment and from 89% to 35% in the freight segment. Meanwhile, all other modes of transport, Road, Air, Pipeline alike, have grown at a much faster rate. The road sector now has 86% of the passenger share and 59% share of freight transport while the railways' share has declined even though rail is cheaper for the customer, economical for the society, and sustainable for the environment. The cost of freight movement by rail is Rs 1.41/NTKM as compared to Rs 2.58/NTKM if moved on road. Further, the unit cost of rail transport is cheaper than road by Rs 1.61/PKM. Railways' energy consumption as compared to road is 75% to 90% less for freight traffic and 5% to 21% less for passenger traffic than road. Rail transport emits much less CO₂ also in comparison with road transport. Rail transport emits 17 gm CO₂ equivalent PKM as compared to 84 gm per PKM in case of road transport. For freight transport railway emits 28 gm CO₂ equivalent per NTKM as compared to 64 gm CO₂ in case of road transport.

In the light of these facts it seems logical that much more investment should have been made in rail infrastructure than was actually done in the last seven decades. As this did not happen, IR's running track kilometers index could move up from 100 in 1950-51 to only 162 even when traffic index for passengers shot up to 1675 and for freight to 1685 by 2018-19. Low investment in rail infrastructure in India has led to heavy congestion on most trunk routes of IR. Notwithstanding the fact that the government is aware of the problems and corrective policies for growth have already been initiated, a sound strategy encompassing the following suggested actions may speed up IR's recovery.

Freight business

Indian Railways has the motto of "Safety, Security and Punctuality" but its priority is largely passenger traffic. For freight, it is business as usual even when two third of IR's revenue comes from freight traffic using only one third of Rail network! Railways' operating ratio is 97.3% for the FY 2018-19; it may be even higher in 2019-20. Breaking up the operating ratio sector wise will show it to be 192% for the passenger segment and 58.72% for freight segment. It is time to re-prioritize in order to improve the financial health of the railways and restore IR to the path of growth.

The National Transport Development Policy Committee report finds the Elasticity of Transport Growth to GDP growth to be 1.20. However, IR's transport growth elasticity is less than 1 when linked with the GDP. Rail freight growth during the period 2001-02 to 2012-13 stood at 5 ½ % and from 2012-13 to 2018-19 at a dismal 2.5% while economic growth during the period from 2001-2002 to 2008-2009 was about 6%. On the other hand, road transport has grown at a much faster rate despite rail transport's apparent advantages in long distance traffic. Clearly, railways are not able to attract traffic due to congestion in the network.

Goods traffic which is IR's primary breadwinner needs to be given due priority. Due to network congestion and low priority given to goods trains, the average speed of goods

trains stands at a meagre 23 km per hour today. This gradual decline in goods trains' speed has led to under-utilization of rolling stock and increased fuel expenses which in turn has precluded IR from realizing due potential of its freight business capacity. Only the Dedicated Freight Corridors (DFCs) can bring back freight traffic from Road to Rail. The completion of the Eastern and Western DFCs is expected by 2021-22. It is expected that once these are commissioned, the average speed of freight traffic would go up to 65-70/kmph from the existing 23/kmph.

Three more DFCs, the Kolkata–Mumbai corridor (called East-West, 2328 km), the Delhi–Chennai corridor (called North-South, 2327 km), and the Kharagpur–Vijayawada corridor (called the East Coast corridor, 1114 km) are in the planning stage. The estimated cost of these corridors is about Rs 4,02,771 crores. These corridors need to be built on priority. If completed by 2030, the DFCs have the potential to push up IR's share of freight to more than 50% from 35% at present. Besides the DFCs, there are a few last mile connections and other projects which have the potential to put IR ahead of all other players on India's freight traffic map.

Passenger business

Railways' passenger revenue for the FY 2018-19 is Rs.51,066 crores out of IR's gross revenue of Rs. 1,89,970 crore. These heavy losses in passenger operations are borne even as passenger traffic clogs two-thirds of the rail network. A primary reason for the losses is that fare has not been increased in the last fifteen years whereas inflation and periodical increase staff cost including pension have led to a hike in railways' operating cost. Ordinary passenger train fares and railways' monthly travel pass are priced much lower compared to bus fares. Numerous concessions continue to exist, even grow, despite their detrimental impact on railway finances. Had passenger fares been rationalized timely, railways could have earned an additional Rs 15000 to Rs 20000 crore which would have contained IR's operating ratio within 90% leaving much needed internal surplus for infrastructure growth. The recent bold decision taken by the Ministry of Railways to open the rail sector to private passenger train operators lends to hope that passenger fares would soon be rationalized. Such steps can help reduce the perennial losses that the railways have been shouldering in the passenger business segment.

IR's passenger traffic has been near stagnant in the last ten years ever since short-distance passenger traffic has shifted to the road sector due to arrival of better roads and motor vehicles while its long distance upper class passenger traffic has shifted to the airline sector thanks to budget airlines dominating India's skies. This rapid growth of the road and air transport sectors is not unrelated to the tardy level of performance of the rail service, especially its average speed which deters today's travelers who value time. If railways are to compete with Road and Air, the speed of intercity trains must increase to 160 km/hr from the existing 110 km/hr to 120 km/hr. For this to happen, railways need upgradation of tracks, better coaches for increased speed, and safety and comfort for the passengers.

It is in the ordinary short distance segment that Railways incur the maximum losses. Stopping at each passing railway station, these 3947 ordinary passenger trains comprise about 29% of the total 13523 passenger trains that ply on IR. The revenue contribution of the

ordinary passenger trains is INR 4666 crore only, a mere 9.14% of the total passenger revenue and an even less 2.5% of the gross traffic revenue. Over a period of time the patronage of most ordinary passenger trains has gone down due to better roads and faster buses being available. It is time to review and cancel the ordinary passenger trains with utilization less than 50% of their capacity.

Cost reduction

The Union Government in India has always had limitations thus preventing it from giving the required budgetary support for capital investments in rail infrastructure. The government has expected Railways to generate the desired internal surplus but Railways have failed in this regard. A major reason for this failure to generate surplus revenue is the increasing cost of maintenance of assets and the operating cost. If the cost of operations is to be reduced, the cost of staff (including pension) has to be reduced first. Staff costs including pension come to 66% of working expenses, which is weighing IR down. Railways is aware of the problem and efforts made in this regard have been able to bring the staff strength below 13 lakhs at present from 16.5 lakhs in 1991. However, this more than 20% reduction in staff strength has not resulted in any savings for the railways as salaries, allowances and pension have grown astronomically with the implementation of the Sixth and Seventh Pay Commissions. At present, remuneration given to government staff is much higher than that in the private sector. Outsourcing some of the Repair and Maintenance activities and mechanization of maintenance of assets are needed to be done early to put a stop to the ever-growing trend of IR's staff costs.

Review of capital investments

IR's capital resources are limited. Therefore, all such projects should be reviewed which do not have the potential to yield the required rate of return. Many new line projects, especially those involving hilly terrain which are disproportionately costlier than road and do not have much potential for freight business, need to be reviewed and shelved.

The need for private investments

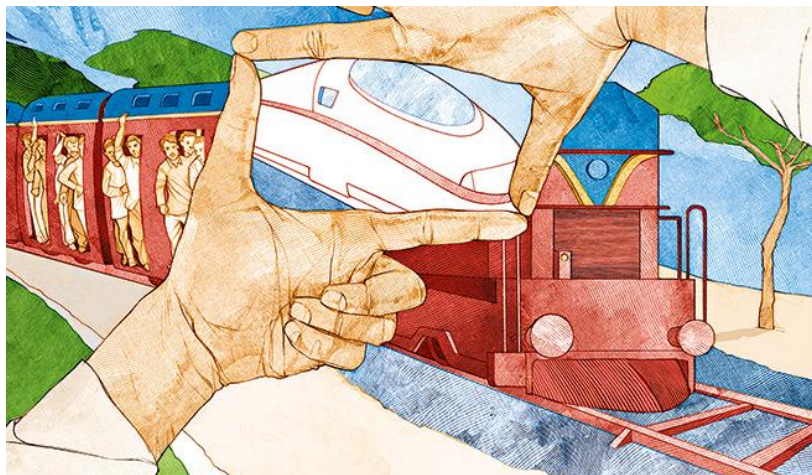
The road and air sectors in India grew at a faster rate than rail since the investment made in these sectors was much more than rail and a major part of it was made by the private sector. On the other hand, the investment for building railways' capacity was dependent on general budgetary support and internal surplus which was always insufficient to the point of being negligible. Thus, IR had to start borrowing funds from the market for procuring rolling stock starting from 1986. In recent years the railways started market borrowing for projects too. In fact, when railways awoke to the urgent need for the Eastern and Western dedicated freight corridors, it had to turn to IBRD and JICA for financing the lines since it was not possible for the government to give general budgetary support for such mammoth projects. A part of the eastern DFC (Son Nagar to Dankuni- 538 km) is being financed through PPP. Similarly, the additional three DFCs, estimated to cost over Rs 4 lakh crores, may also have to be financed by multilateral agencies or through PPP.

In the early 2000s, Indian Railways had permitted entry of a few small non-Government Railways, eg, KRCL, PRCL, through the PPP route. This investment is a very small part of the total private investment in IR. In order to attract more private investment, in December 2014, Railways came up with schemes for investment in rail projects involving suburban

corridors, Mass Rapid transport System, High Speed trains, Rolling stock, Freight & Passenger terminals and Industrial parks, etc, through various models of private investment. Ever since, two locomotive factories have opened in Bihar as joint ventures with 26% share of Railways and 74% share of Alstom and GE. This investment is of the order of Rs.40000 crore with the object of manufacturing 1900 high power locos as part of the Make in India scheme. Another prestigious project, the High-speed train project between Mumbai and Ahmedabad, is in progress by getting technology and finance from Japan.

Very recently, Indian Railways have called for Expression of Interest from private operators for running passenger trains with private investment on IR's network. The tender has been invited to run 151 passenger trains with speed up to 160/kmph on 109 routes in twelve clusters. Private Sector is expected to invest Rs.30000 crore in this venture. If these bids are successful, many more such trains can be run with private investment. If these bids are successful, many more such trains can be run with private investment and hope for improvement in Indian Railways' financial health will become a reality.

The writer is Director-General, IRIFM. He has handled diverse portfolios in open line railways, production units, construction, and has also worked as Divisional Railway Manager in North-Eastern Railway.



Did you know?



The world's oldest meter-gauge line ran between Garhi Harsaru and Farukh Nagar, near Delhi. Inaugurated in February 1873, this 12.3-km line has now been converted into a broad-gauge line. In 1982, while shooting Gandhi, director Richard Attenborough used Garhi Harsaru station as a stand-in for the South African station of Pietermaritzburg, in the scene in which the Mahatma was thrown out of the railway carriage.

Cogito

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