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Modeled to bits: Decision models for the digital, networked economy

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Abstract

Leeflang and Wittink [Internat. J. Res. Marketing 17 (2000) 105] sketch a future for marketing modeling that differs primarily in scale and scope from today's environment. We have a different vision: the digital networked economy will induce significant structural changes in (a) how models are developed and deployed, (b) who uses marketing models, and (c) what types of models are developed. To be successful, marketing modelers must adapt by gaining a better understanding of the role of marketing modeling in the new environment and by learning how to use emerging information technologies (IT) for developing, deploying, and validating marketing models. © 2000 Elsevier Science B.V. All rights reserved.

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1. Introduction

Leeflang and Wittink (2000) provide a useful historical perspective on the field of marketing decision models and offer their vision of developments to come. We expand on their discussion of how the Internet and, more specifically, the World Wide Web (WWW), will influence the development, deployment, and use of marketing decision models. The Internet is bringing about major changes in how businesses are conceived and managed, ushering in the era of e-business. Our goal here is to articulate how model deployment and use are changing because of the Internet: How will the Internet change the environment for marketing modeling? And, what should marketing modelers do to better adapt to this environment?

We first describe three important ways the Internet influences marketing modeling: (1) It de-couples model, data, and the user interface, unlike traditional models that integrate these components. (2) It expands the reach of marketing models to a much broader, more heterogeneous group of users. (3) It vastly increases the opportunities for gathering and using data, information, and insights to support decision-making. We then sketch the new challenges facing model developers working in the Internet environment, and the new kinds of thinking they must embrace to encourage wider and more effective use of their models.

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2. Marketing modeling on the Net

2.1. De-coupling models, data, and user interfaces

The Internet is built on the client–server architecture for computing. Because of this architecture, a client (e.g., a manager using a browser) can access software applications (e.g., marketing models) located on servers anywhere in the world. Further, the data required for executing the models can be located on servers elsewhere. In contrast to traditional models on standalone computers (where these elements are typically integrated), this architecture permits a model, its data, and the user interface to be de-coupled as shown in Fig. 1. This de-coupling can both enhance the scope of models used by managers and improve the speed and convenience associated with using those models. In particular, a user can employ a simple universal tool (i.e., a browser) as a model interface, provide real-time data feeds for model execution, and integrate multiple data sources and models to address specific marketing decision problems. See Krishnan and Padman (1997) and Bhargava and Krishnan (1998) for more detailed discussions about how the Internet's architecture creates flexible modeling environments.

On the Internet, knowledge resources (e.g., content, data, and models) are digitized, decentralized, and networked. Thus, these resources can be combined when and where needed, driven by user needs. However, before this opportunity can be fully exploited, knowledge resources must be given the same "name tags" throughout a distributed system. Thus, words like "repeat purchase" or "Bass model," must be interpreted in an identical way by all the systems sharing the common knowledge resources. Standards and protocols, such as Extended Markup Language (XML), Resource Description Framework (RDF), Remote Method Invocation (RMI), Common Object Resource Broker Architecture (CORBA) — a more general version of RMI — and Microsoft's version of CORBA, called Distributed Component Object Module (DCOM), make it feasible to use consistent tags and data and communication structures for developing models that can be deployed on the Internet.

The emerging flexible modeling environment of the Internet can greatly expand the deployment and use of marketing decision models. We envision a continuum of marketing models, classified along two dimensions, which can be leveraged on the Internet, shown in Fig. 2. On the horizontal axis (Degree of Integration), we distinguish between standalone models (e.g., supporting a single user for a single task) on one extreme and those that are integrated with organizational processes, databases, and other

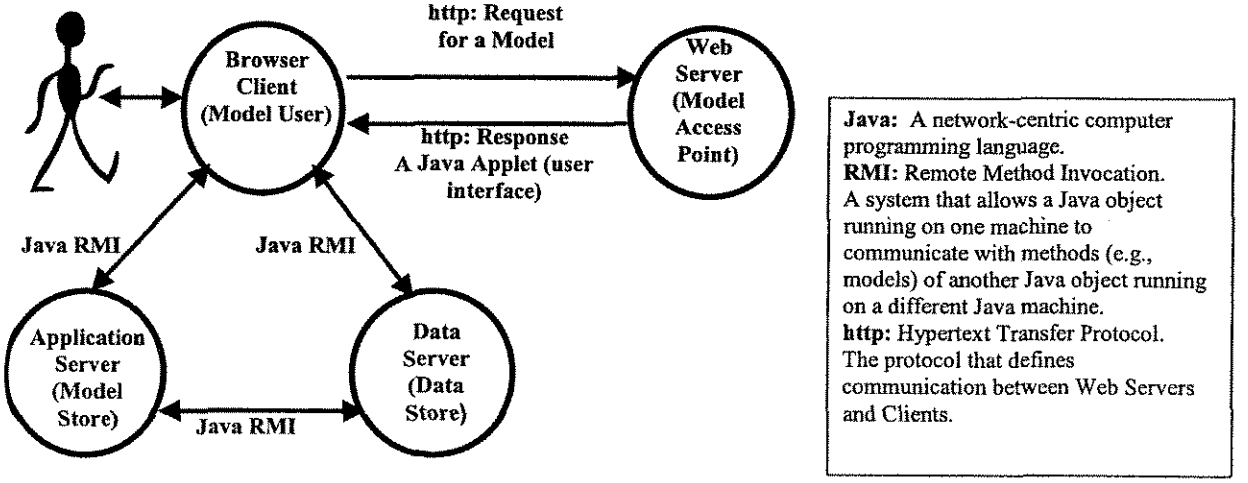

Fig. 1. Modeled to bits: one approach by which models, data, and user interfaces, traditionally combined together, are de-coupled in a web environment.

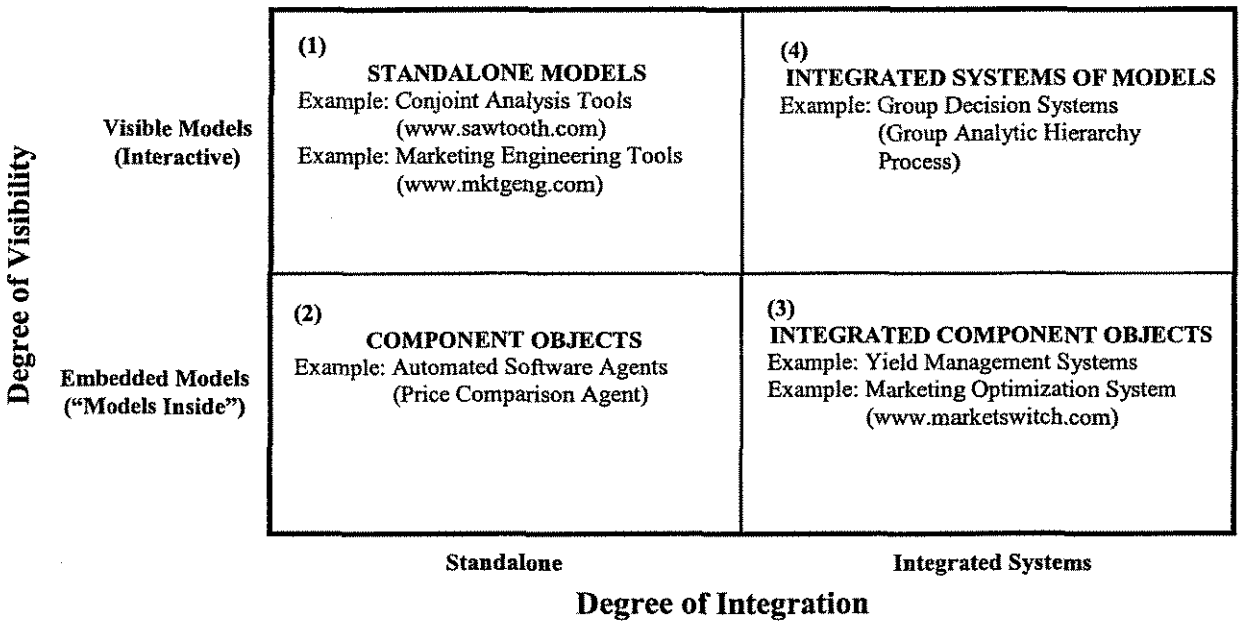

Fig. 2. Marketing models classified by degree of integration and degree of visibility that can be deployed on the WWW.

aspects of the decision environment, at the other extreme (e.g., single user, multiple tasks; multiple users, single task). On the vertical axis (Degree of Visibility), we distinguish between models that are embedded inside systems (i.e., a "blackbox model" that works in the background) requiring few inputs or interactions with the user, and those that are highly interactive and whose structures are visible. We discuss below four categories of models that fall at the extremes of these two dimensions and indicate how the networked economy will enhance their use.

(1) *Visible standalone models* can be put on application servers (Application Service Providers are already emerging, e.g., www.marketswitch.com) and accessed by client browsers. In such an environment, software renditions of marketing models can be maintained in central locations, minimizing costs of updates and distribution. Model users also benefit because they will always have access to the latest versions of the software. Visible models with user interactions can also become more valuable online. For example, applications ranging from simple computational devices, such as mortgage calculators (www.jeacle.ie/mortgage), to sophisticated programs, such as conjoint analysis (www.valueharvest.com), are available on a 24/7 basis. These applications are enhanced with online technical help (both with machine intelligence as well as live support), improved content (help files, tutorials, etc.), and linked to related applications that are available elsewhere on the Internet. Many traditional marketing models, such as the Bass Model, would also benefit from being re-designed or re-implemented in newer software packages, for deployment over the Internet.

(2) *Component objects* can be deployed more widely on the Internet because they can be structured to continuously monitor and optimize various aspects of how an organization functions. Proctor and Gamble's access to purchase data for their products at Wal-Mart allows P&G to deploy automated models to forecast demand, schedule production and delivery, optimize inventory holdings and even assess the effectiveness of their promotions.

(3) *Integrated component objects* exploit the blurring lines between software, content, services, and applications to deliver more complete decision solutions to managers. For example, an integrated segmentation system could run not only standard clustering algorithms, but could also access data from elsewhere on the web before model execution, and then distribute customized communications to customers in different segments. Yield management sys-

tems at the world's major airlines dynamically optimize schedules, prices and seat inventories and send messages to targeted customers about new travel opportunities that they might find attractive. Although such models may be fully automated, or used by unsophisticated users, the models themselves are likely to be quite sophisticated (akin to an autopilot for an aircraft) and require frequent updating and validation by highly skilled modelers.

(4) *Integrated systems of models* put a logically linked set of models in the hands of decision-makers (possibly geographically separated) who need to share their different knowledge bases for important common decisions. (e.g., negotiation support, bid planning, marketing planning models). For example, Lodish et al. (1988) described a subjectively calibrated market response model that required co-location of the decision-makers. In the Internet world, such subjective data inputs can be obtained online from managers in different locations, consensus developed using models running on a server, and the resource and planning implications made available to all through a group decision support system.

Note that the Internet tends to drive the prices of digital products (i.e., products, such as marketing models, that can be distributed on the Net) down to their marginal production costs, which are near zero (Evans and Wurster, 2000). As a result, many Internet-based models will be available almost free, at least for limited use (or offered in exchange for viewing commercials, etc.), making them even more attractive for analysts and managerial users alike. Thus, we expect an explosion in the availability of customizable, scalable and (possibly) embedded decision models on the Internet, available anytime, anywhere, for anyone.

2.2. More heterogeneous mix of model users: Where are the analysts in the e-world?

As more consumers and businesses get connected to the Internet, the clientele for marketing models expands. Not long ago, the only people using marketing models were analysts, consultants, and marketing academics. This situation is giving way to a more heterogeneous mix of model users, including students and frontline managers. For example, our Marketing Engineering (Lilien and Rangaswamy, 1998) students come to class, connect their laptops to the Internet and access data and information relevant to the class in real time. They have access to many analytic tools, often in the form of spreadsheet software like Excel (along with key add-ins), which provide a wide range of readily available capabilities. Our students are increasingly employed in startups or in flat organizations where rapid decision-making is essential and seasoned analysts are not available to help. They are "empowered" early on in their jobs to make decisions with the software, hardware, and data they can access online. Or, perhaps to look at it from their point of view, they are literally "abandoned" in a world of personal modeling with little analytical support staff.

Fig. 3 gives a perspective on personal (or self-service) modeling, which is becoming a more common context for marketing decision models in the new economy. Personal modeling involves small to medium scale decisions that must be made in a very short time, decisions that may not re-occur (at least not for the same individual) and need only moderate skills to perform the associated analyses. Such environments are characterized by:

- limited modeling knowledge and ad-hoc modeling processes, without the luxury of quick access to trained human analysts;
- nonmathematical modeling, where the modeling process relies heavily on graphics, web-content, spreadsheets, and canned software to build an appropriate model;
- severe budget and time constraints, where an acceptable answer is needed immediately, forcing the modeler or user to rely heavily on assumptions and judgments about many model inputs;
- modeling more for general insights (which products or policies seem to perform better than the others) than for specific numerical results.

Are decisions made in such environments worse than when formal, objective decision models are put together? While evidence seems to suggest (not unequivocally) that formal models built by skilled analysts work better, the more appropriate question is whether the systematic use of models based on judgmental inputs works better than pure judgmental

Criterion	Personal models	High-end models
Scale of problem	Small to medium	Small to large
Time availability (for setting up model)	Short	Long
Costs/benefits	Low to medium	High
User training	Moderate to high	Low to moderate
Technical skills for setting up model	Low to moderate	High
Recurrence of problem	Low	Low or high*

Fig. 3. Characteristics of two extremes of marketing decision models: personal versus high-end models. These models can fall in any of the four categories described in Fig. 2, although managers would most likely develop simple standalone "personal" models. * Low for one-time studies (e.g., Marriott Conjoint Study, Wind et al., 1989) and high for models in continuous use (e.g., American Airlines Yield Management System, Smith et al., 1992). Source: adapted from Powell, 1997.

decisions alone. The answer here appears to be yes as well (Russo and Shoemaker, 1989).

A well-trained marketing scientist or analyst may, for good reasons, be skeptical about providing sophisticated modeling tools to unsophisticated users. However, demand for help at the point of decision-making in a networked economy will force us to improve the design and delivery of models, so that they can be used by people with widely varying modeling skills. So, what do we have to look forward to? As learning and work become more contemporaneous, managers will expect access to information, knowledge, and models that are just a few clicks away on the Internet — that we will have *modeling on demand* (Fig. 2, Box 1).

2.3. Data, data everywhere: What's a modeler to do?

It is no news that the Internet is fueling an explosion of marketing data way beyond what we have seen over the past few years (e.g., scanner data). Web servers record clickstream data — what people are looking at, for how long, in what sequence, and what products they order (if any). Chat groups and forums record every message posted at those sites. Ad delivery systems (e.g., Doubleclick) record where every banner ad is displayed. Companies, such as bizrate.com, are recording user experiences regarding web shopping. The list goes on. We are seeing marketing data collection on a scale that was unimaginable just a few years ago. A single successful portal (e.g., Amazon.com) collects over 30 gigabytes of data per day (about 2–3 million pages of text) in its server logs.

Most large web-databases currently available contain mostly behavioral data — they capture what people do. To understand the reasons for the observed behaviors, we have to infer those reasons through modeling efforts, supplementing clickstream data, for example, with data on past purchases and data from surveys. Even with purely behavioral data, we need new models to capture the richness of the marketing data sources. For example, Wu and Rangaswamy (1999) develop a consideration set model to explore whether online search and sort behavior changes how many brands consumers include in their consideration sets (i.e., the brands they would consider buying). Understanding such behavior would enable marketers to design strategies to increase the chances that their brand would be one of the brands considered by consumers before they make a purchase. As another example, Fader and Hardie (1999) develop a model to determine whether repeat purchase rates are increasing, decreasing, or staying steady, and to understand the drivers of repeat purchase rates. Mahajan and Venkatesh (2000) summarize the models and findings that are beginning to emerge.

In addition to the exploding quantities of marketing data, we are also beginning to see data that cover a wider range of marketing phenomena. For example, with online grocery shopping data (Degeratu et al., 2000), we not only have the information that is

typically available in traditional scanner panels (e.g., price and promotion), but also detailed data about the navigation process of users during a web visit. With such data, we can develop richer models that are likely to offer more valuable diagnostics about the "why" as well as the "what" of shopping behavior. Other types of data, such as those captured by e.piphany.com, which records customers' search behavior, should also produce new marketing models that incorporate customer decision processes and allow for heterogeneity in decision-making. New developments should include product customization using interactive conjoint models, and dynamic and customized promotions (constructed on the fly) based on hierarchical Bayes models or Bayesian network modeling.

3. Becoming better modelers in the digital, networked economy

There is clearly much that marketing modelers should do to adapt to, and exploit, the new modeling environment. We suggest three actions here: (1) become more familiar with information technologies (IT); (2) build more (decision) relevant models, and (3) do more real-world assessments of the value and impact of their models.

3.1. Become more familiar with IT

Most traditional marketing models (at least those developed by academics) have focused on the modeling components themselves and not on factors that enhance how the models will be used (exceptions include models, such as those based on the Decision Calculus approach, Little, 1970). Increasingly, models that do not design in features that take advantage of the distributed and data-rich context provided by the Internet (previous section) will become irrelevant: they will not get used, and will have diminished importance to future developments in the modeling field. To develop models that do get used, modelers must pay attention to the IT-infrastructure under which their models will be used.

Many important decision modeling opportunities today are related to IT-based modeling, where models are developed and driven by newer types of marketing data that are generated and made available through corporate (e.g., web logs), syndicated (e.g., scanner data), and commercial databases (e.g., MediaMetrix data: www.mediametrix.com). These developments have spawned new modeling approaches designed for IT-intensive environments, where the models will be used by different types of users (e.g., consultants, managers, analysts, etc.). Researchers in computer science, finance, physics, and other areas are developing and testing newer modeling techniques, such as Bayesian networks, neural networks, and data mining. However, marketing modelers (especially those in academia) have yet to embrace these modeling approaches, and we risk becoming marginalized as thought leaders if vendors and practitioners deploy models based on these newer methods without rigorous and independent assessments of their validity and value. We do not suggest that marketing scientists become IT experts — rather we marketing scientists must learn to work with IT experts who can help us leverage our models for wider deployment to determine what works, what does not, and to identify areas for future modeling research.

3.2. Build more relevant decision models

In an environment characterized by rapid change and constant experimentation, data, by themselves, are of little value unless they can be deployed quickly to drive decisions that impact company performance and profits. Marketing models can help transform data into actionable insights in four ways: (1) by helping us understand and leverage customer attitudes, preferences, and choices; (2) by helping us understand and leverage marketplace (competitor) behavior, (3) by harnessing managerial insights and judgments and (4) by deploying models more widely within the firm. Leeflang and Wittink focus mostly on the first area; we outline some ideas about the others.

3.2.1. Understanding and leveraging marketplace (competitor) behavior

The Internet has fostered a network-centric approach to business. Increasingly, successful firms find that they are becoming focal players in a complex ecosystem (a node connected to many subnodes). At one time, IBM dominated the computer industry and drove the pace of development there.

The company often waited to introduce a new product until its R&D department had developed the next generation product. In the networked world, where knowledge is distributed across an interconnected set of players, IBM is more of a "focal player" that leverages developments wherever they occur. For example, recently, Ariba, i2, and IBM announced a joint venture to co-develop and deploy e-commerce systems. Likewise, Amazon.com has recruited a large number of "Associates" to drive traffic to its site. As marketplace behavior is driven by such complex interactions between players, there is an increasing need for the development of simulation models to help managers evaluate strategic options.

Simulation models facilitate anticipatory learning to enable managers to try out alternative scenarios in a safe environment before committing real resources. While there are several successful simulation models in marketing (e.g., the Assessor new product development model, Silk and Urban, 1978, conjoint simulators, etc.), most of these models are aimed at simulating consumer behavior. There are also some teaching tools to help simulate real-world competitive behavior (e.g., Markstrat, Capstone (www.capsim.com), and Photowars). However, in the networked economy, there is an increasing need for models that simulate competitive and marketplace behavior using real-time data feeds from multiple sources. For example, a decision system designed to continuously monitor, measure, and simulate banner ad effectiveness across a network of partner sites could quickly suggest ways to optimize ad deployment. If a news event at a golf tournament suddenly increases traffic at golf sites, triggering improved effectiveness of banner ads presented there, an advertiser for whom this target segment is important can then redirect more of its advertising expenditures to those sites. Such a capability will become more important as firms try to gain competitive advantage by rapid adjustment of effort deployment to reflect the continuously changing marketing response patterns characteristic of a networked economy.

3.2.2. Harnessing managerial insights and judgments

No matter how much data and how many models are available, managerial judgments will play a decisive role in most decisions, especially those that have strategic (as opposed to operational) consequences. Indeed, if more models and data are available, model users are likely to have to make more, rather than fewer, judgments. Hard data represent the past and judgments reflect beliefs about the future. And more data will force more careful assessments of more aspects of the future. Increasingly, successful models will be those that encourage and help bring out individual and collective managerial judgments (e.g., judgments about the range of a model parameter).

3.2.3. Deploying models more widely in firms

Having data and information is not enough to improve organizational performance; they must be deployed when and where they are needed, which may require "mass customizing" reports, dynamically tailoring them to the needs of individual managers. To encourage broader use, models can be linked to internal databases and Enterprise Resource Planning (ERP) systems, thus linking them to IT systems already in wide use in companies. But before models can be widely adopted, managers must trust the insights they produce (cf., Moorman et al., 1992). Managers must also feel comfortable that models complement, and not override, their judgments. Another way to increase model use is to make them an integral part of how an organization functions by embedding them in larger IT systems (e.g., a forecasting model embedded in an order processing system). If the overall system performs well, the embedded model may be deemed to be successful, and is likely to be used on a regular basis. In areas such as yield management, direct marketing, and segmentation there are numerous opportunities to put "Marketing Models Inside" existing business systems.

3.3. Do more real-world assessments of the value and impact of marketing models

To drive both our research and our teaching, marketing academics need a better understanding of how and why models either get used or get rejected by managers. By all accounts, many fewer models are actually used than are developed. Is the problem with our models, or just with their interfaces and

distribution mechanisms? If it is the latter, we need research to find better ways to get our models used. If it is the former, we should explore alternative approaches, like Artificial Intelligence (AI), that are beyond our traditional toolkits derived from statistics, operations research, and psychology.

As more models are deployed on the Internet, model usage will become easier to monitor and measure. Who are using marketing models? How are they using the models? What features are they using most? Using least? Answers to these questions will help develop models that are most likely to be used. We envision alternative versions of models being available on the web, in different forms, so that we can observe what model features and structures "win" in the marketplace.

Models take time and often cost substantial amounts to develop. Much marketing analysis is viewed by firms as expense; we need frameworks and measurement procedures to assess the business and financial benefits associated with model use. We see the value of models both in changing actions (instrumental view — "short-term earnings") as well as in changing minds (larger view — "options" perspective). The Leeflang and Wittink paper frames modeling as an activity focused on faithfully capturing marketing phenomena. That view by itself will not support a vibrant future for our field. We also need more studies on the impact of models — the demand side of the equation (see Wierenga and van Bruggen, 2000) — to better understand what works, what does not and why — and to apply that knowledge to provide modeling on demand for the networked economy. Past studies on the effectiveness of Decision Support Systems have mostly been conducted in laboratory with few exceptions (e.g., Gensch et al., 1990). Although such studies generally indicate that DSSs improve decision performance, the results are mixed (see, for example, reviews by Sharda et al., 1988 or Benbasat and Nault, 1990). Further, most past studies have not carefully identified the features of the decision models or the accompanying decision processes that have the most influence on effectiveness or performance. However, when models are deployed on the Internet, the real world becomes the laboratory, and by monitoring and tracking model use and firm performance in this environment, we can more clearly see how modeling research, development, use, and effectiveness relate to one another.

4. Conclusions

In this commentary, we have focused on how the digital, networked economy provides both challenges and opportunities for marketing modelers. Our key challenge is one of retooling: traditional marketing modelers who are not net-savvy risk having their work becoming marginalized and irrelevant in the digital age. Our opportunities are enormous: in the networked world, anyone, anywhere, anytime can be an active (e.g., consultant, decision-maker) or passive (e.g., implementor) participant in a marketing decision system. The potential demand in the areas of research, teaching, and practice for what we are capable of providing has never been greater; let us see if we are both clever and dedicated enough to exploit these opportunities and meet the associated challenges.

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