A Fit-Gap Analysis of E-Business Curricula vs. Industry Needs

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Despite the dot-com bust, e-business continues to expand, as many large, traditional businesses embrace it as a key component of their competitive strategies [8]. Forrester Research has estimated that e-business is expected to grow to $6.8 trillion worldwide by the year 2004, with its impact felt in almost every segment of the global economy [6].

E-business is *"the conduct of business with the assistance of telecommunications and telecommunications-based tools"* [4]. This definition covers a broad range of activities, from business-to-business (B2B), to business-to-customer (B2C), to intra-organizational commerce [9]. The plethora of opportunities opened in this cyber-frontier has taken the spirit of entrepreneurship to dizzying heights in the last decade [1]. However, the Achilles' heel in this new economy is the lack of IT professionals with the right skill sets—a constant complaint from recruiters [3, 7]. Clearly, the e-business big-bang caught most academic institutions by surprise, finding them unable to respond with the requisite programs or courses. However, over the last several years, we have seen a discernible upsurge in e-business programs to overcome this lag, especially in top US business schools. The nature of this response varies considerably among schools. Some have rejected outright the need for a separate e-business program, whereas others have embraced and staked their reputations on their new e-business programs. Are these programs producing the right kinds of graduates for industry? What are the core and optional courses in e-business programs? This study investigates the alignment of e-business academic programs with the e-business job market. A fit-gap analysis was performed to identify where e-business programs are on target and the gaps that need to be filled by new e-business courses.

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E-Business Programs

The top business schools, ranked independently by *US News* (33 schools) and *Business Week* (30 schools), were selected as our sample. Since the two rankings have a fairly high degree of overlap, and some of the schools do not offer e-business courses, we came up with a total of 38 schools in our sample (Table 1). The *US News'* ranking is for the top

Rank	US News	Business Week
1	University of Pennsylvania*	University of Pennsylvania (Wharton)
2	Massachusetts Institute of Technology* University of Michigan-Ann Arbor*	Northwestern (Kellogg)*
3		Harvard
4	University of California-Berkeley*	MIT (Sloan)
5	Carnegie Mellon University* University of North Carolina-Chapel Hill* University of Texas-Austin*	Duke (Fuqua)
6		Michigan
7		Columbia
8	New York University* University of Virginia*	Cornell (Johnson)
9		Virginia (Darden)
10	Indiana University-Bloomington* University of Illinois-Urbana Champaign University of Wisconsin-Madison*	Chicago
11		Stanford*
12		UCLA (Andersen)*
13	Purdue University-Lafayette* University of Minnesota-Twin Cities* University of Southern California*	NYU (Stern)
14		Carnegie Mellon
15		UNC-Chapel Hill
16	Emory University* Ohio State University-Columbus* Washington University in St. Louis	Dartmouth (Tuck)*
17		Texas-Austin (McCombs)
18		UC Berkeley (Haas)
19	Michigan State University* Pennsylvania State University-University Park	Yale*
20		Indiana
21	Babson College* Case Western Reserve University* University of Arizona* University of Florida* University of Maryland-College Park* University of Notre Dame* University of Washington*	Rochester (Simon)*
22		Vanderbilt (Owen)*
23		Washington University (Olin)
24		USC (Marshall)
25		Purdue (Krannert)
26		Georgetown (McDonough)
27		Maryland (Smith)
28	Arizona State University* Georgetown University* Texas A&M University-College Station* University of Georgia* University of Iowa* Wake Forest University*	Emory (Goizueta)
29		Michigan State (Broad)
30		Georgia Tech (DuPree)*

(Source: US News Undergraduate Business Program Ranking 2001 & Business Week's MBA Ranking 2001)
*E-business programs used in the analysis. Those listed twice (that is, once across both lists) are marked only once. All e-business programs and courses were reviewed at both graduate and undergraduate levels within each university. Total = 38.

Table 1. U.S. business school rankings.

undergraduate business programs, and *Business Week* ranks the top MBA programs. This sample, in our judgment, is representative of the past trends and the future projections in the e-business educational arena, since these are the top business schools in the nation, and they set the standard for education. It should be noted that the two lists provided us with a means to select our sample; but, when performing data collection, we looked for undergraduate, graduate (MBA, EMBA, and MS), and certification e-business programs in each school—irrespective of the list in which the school appears.

A content analysis of the top business schools' Web sites reveals six types of e-business programs (Figure 1). Most of the existing programs are at the graduate level. Some programs are more focused (that is, an e-commerce program with sub-tracks), while others are subcategories of existing programs (for example, MBA concentration). We also observed that some schools are beginning to offer certification programs in e-business. These are typically shorter programs, and the aim is to train existing IT professionals in e-business. The duration of the graduate programs vary from 1–2 years, while the certification programs are less than one year. Also, it is important to note that several schools in our sample offer only a small number of e-commerce courses (for example, 2-3), without having a formal program (that is, major, concentration, or certificate) in place.

Based on the content analysis, we identified a total of 391 different e-commerce courses (52 (13.3%) undergraduate and 339 (86.7%) graduate courses), which were classified into the 24 categories shown in Table 2. A detailed analysis of the courses offered by these schools shows that there are two broad and distinct tracks in e-business curricula. One track paves the way for an e-business career with a predominant
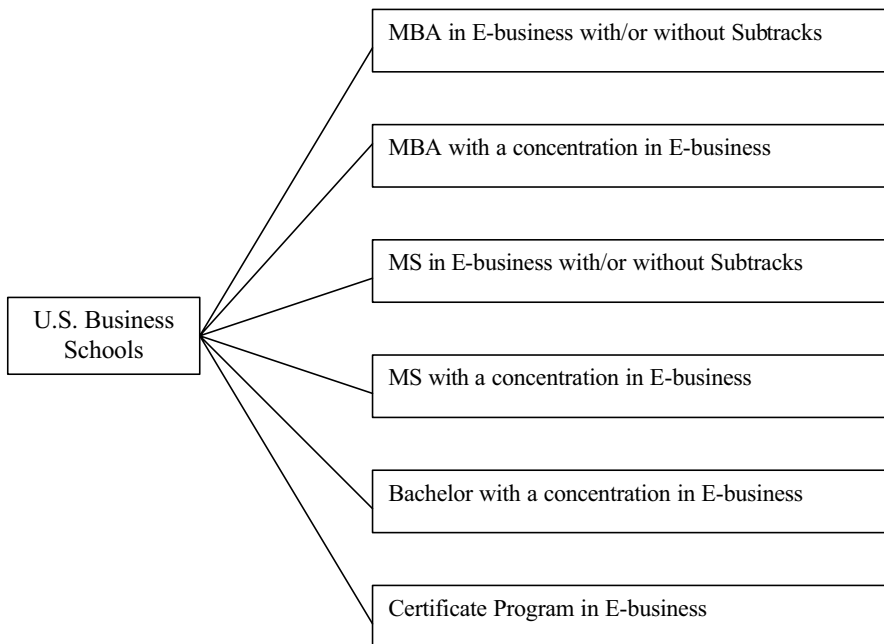
Figure 1. Types of e-business programs.

E-Business Marketing (17.5%)
E-Business Strategy (12%)
Introduction to E-Business (11%)
Data Communications (9.5%)
E-Business Management (6%)
Entrepreneurship in E-Business (6%)
E-Business Economics and Markets (5%)
E-Business Systems Development (5%)
Operations and Supply Chain Management (5%)
E-Business Technology (5%)
Data Management (3%)
E-Business Practicum (2.5%)
Global E-Business Management (2%)
Business Process Reengineering in E-Business (2%)
Interface Design (2%)
Legal and Regulatory Issues in E-Business (1.5%)
E-Business Security (1.5%)
Java and Object-Oriented Programming (1%)
Business Models in E-Business (1%)
Enterprise Resource Planning (0.5%)
Electronic Payment Systems (0.25%)
Computer Ethics (0.25%)
Intelligent Systems (0.25%)
B2B (0.25%)

Each percentage value represents the number of courses in a category relative to all courses in the survey.

Table 2. Categories of e-business courses offered in business schools.

focus on the business aspect, whereas the other track leads to a career emphasizing technology and Web-based systems development.

Business track. Within the superset of e-business, this track consists of core courses in Law, Marketing, Finance/Accounting, and Infrastructure and Technology for the

Internet. The electives are geared towards shaping a career in the areas of E-Business Analysis, E-Merchandising, E-Business Financial Analysis, Cross-Functional Enterprise Architecture, and E-Commerce Entrepreneurship. Often, a practicum is also included to expose students to the industry and provide hands-on work experience.

Technology track. This track typically starts with prerequisite/core courses in basic programming (such as C++/Java), E-Business Systems Analysis and Design, Database Design and Implementation, and Web Development. These specializations are geared towards entering into technical positions in industry such as Web Development, Technical Consulting, Systems Integration, Web-based ERP Analysis, Wireless Telecommunications Analysis, XML Development, E-business Infrastructure and Technical Architecture, and E-Solutions Entrepreneurship.
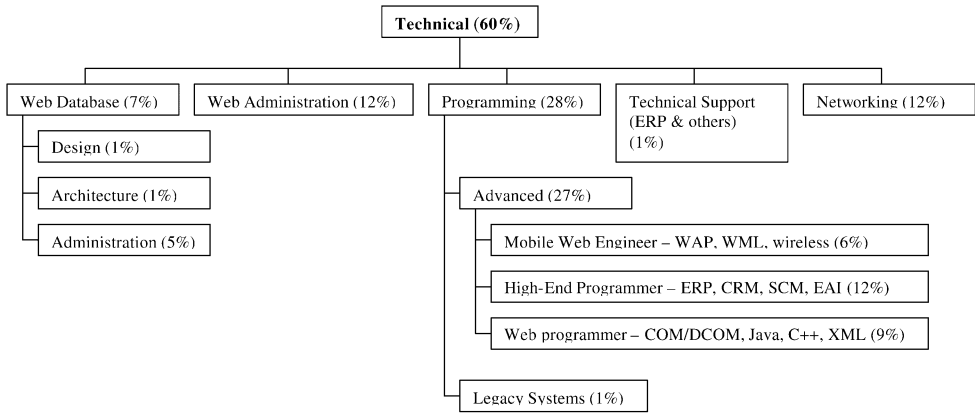
Industry Needs for E-Business Skills

The second aspect of our study assesses industry demand for e-business professionals and the skill sets needed for specific e-business career tracks. To perform this analysis, we conducted an extensive content analysis of e-business job listings on major US Web job sites. Eight career Web sites were selected: BrassRing.com, CareerBuilder.com, Dice.com, Collegerecruiter.com, HeadHunter.net, Jobsonline.com, Kforce.com, and Monster.com. These were ranked the top sites by Alexa Research and PC Data Online in 2001 [5]. Around 1,000 online job postings were coded independently by two researchers. The two sets of classifications were then compared, and minor differences were resolved.

The content analysis focuses on two outcomes: identifying general categories of e-business professions (for example, Web site developer, Java programmer, data base specialist), as well as the relative percentage of positions within each profession; and, the specific job skills required for each type of position.

The analysis of the data reveals several interesting facts: out of the approximately one thousand job postings, 60% were technical job postings and 40% were in the management category; technical job postings can be further subdivided into programming (28%), Web administration (12%), networking (12%), Web-database (7%), and technical support (1%); the management job category consists of consultant (19%), manager (12%), analyst (8%), and other (1%) (such as technical writer, human resources). Figures 2 and 3 show the breakdown of technical and managerial positions.
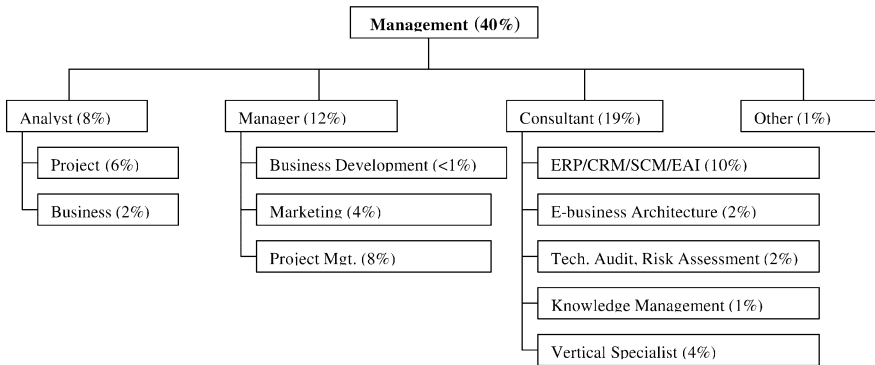
For the e-business technical job postings, common skill sets include: Unix, C++, Java, SQL, Visual Basic, HTML, ASP, Oracle, SQL Server, TCP/IP, OO Programming, wireless application protocol (WAP), wireless markup language (WML), XML, ERP Applications, LAN/WAN technologies, common object request broker architecture (CORBA), Cold Fusion, Photoshop, Dreamweaver/Front Page, and distributed component object model/component object model (DCOM/COM).

As for the e-business managerial skill sets, job postings fall into two categories: *general* managerial skills and *e-business-specific* managerial skills. With regard to general managerial skills, most are very similar to traditional managerial skill sets. One possible reason is that managerial skills are less domain-specific than technical skills. The most commonly listed e-business managerial skill sets are: self-motivated with proven decision-making abilities; strong analytical and problem-solving skills; ability to communicate results of work in technical and non-technical terms; ability to train and motivate personnel; abil-

Technical (60%)

Web Database (7%) — Design (1%), Architecture (1%), Administration (5%)

Web Administration (12%)

Programming (28%) — Advanced (27%) — Mobile Web Engineer – WAP, WML, wireless (6%); High-End Programmer – ERP, CRM, SCM, EAI (12%); Web programmer – COM/DCOM, Java, C++, XML (9%) — Legacy Systems (1%)

Technical Support (ERP & others) (1%)

Networking (12%)

Each percentage value represents the percent of all job postings (both technical and managerial).

Figure 2. Technical positions in e-business.

Management (40%)

Analyst (8%) — Project (6%), Business (2%)

Manager (12%) — Business Development (<1%), Marketing (4%), Project Mgt. (8%)

Consultant (19%) — ERP/CRM/SCM/EAI (10%), E-business Architecture (2%), Tech. Audit, Risk Assessment (2%), Knowledge Management (1%), Vertical Specialist (4%)

Other (1%)

Each percentage value represents the percent of all job postings (both technical and managerial).

Figure 3. Managerial positions in e-business.

ity to work well under pressure; build multitier object-oriented client server applications; coordinate and manage multiple projects simultaneously; and industry knowledge or business process knowledge.

The e-business-specific management skills that are highest in demand include: project management and analysis skills (14% of job listings); the ability to integrate Web-based applications with ERP, CRM, SCM, and EAI (10%); use of the Web for vertical industry specialization (for example, financial services, health care) (4%); and, Web-based marketing management (4%).

Most demanded technical skills include: high-end programmer (ERP, CRM, SCM, EAI) (12%); networking and systems professional (12%); Web administration (12%); Web programming (9%); and, mobile Web engineer (6%). These skills are shown in Table 3, along with examples of specific skills within each category. While

Management Skills	
Consultant (ERP, CRM, SCM, EAI) (ERP application development, change control, UNIX shell scripting, object security, CRM process analysis, sales ordering, customer service, DB marketing, inventory mgt., DB modeling, Web and client server design Java, SQL, interface design, B2B software, EDI, SCM experience, warehouse mgt., network modeling)	10%
Project Management (project planning, issue/risk mgt., scope management)	8%
Project Analyst (UNIX, NT, database mgt., SQL, front-end applications (e.g., SAS), Lotus Notes, relational DB, object-oriented design (UML), interface development, Web development)	6%
Consultant (Vertical Industry Specialization) (industry knowledge (e.g., healthcare, telecom., retailing), Web-based tools, integration of Web with industry knowledge)	4%
Marketing Manager (mktg. communications, project mgt., organizational skills, communication skills, use of Web in brand building)	4%
Technical Skills	
High-End Programmer (ERP, CRM, SCM, EAI) (SAP, People Soft, Oracle, Baan, One World, Ariba, Commerce-One, MS Site Server, EDI, Java, XML, Oberon, and a variety of Web-based development software)	12%
Networking and Systems Professional (Windows, PC and server hardware, Exchange mail systems, UNIX admin and shell scripting, Solaris or HP UX, WANs, Cisco router configuration, network security (e.g., firewalls), Web servers)	12%
Web Administration (on-call, off-hours support, UNIX or Windows support, ASP, Java, Visual Basic, COM/DCOM, project mgt., Sun Solaris, HP UX, AIX, LANs, WANs, DNS, Web development tools, database)	12%
Web programmer (Web development software (e.g., Dreamweaver, Frontpage, Photoshop, Fireworks, Drumbeat, Flash), Java, Java script, Visual Basic, ASP, HTML, XML, Cold Fusion, Active X, C++, COM/DCOM, Oracle, SQL Server, PERL, Apache, UNIX)	9%
Mobile Web Engineer (WAP, WML, Wireless) (Java, RMI, CORBA, WML, XML, ASP, CDMS, WAP, GRPS, Palm OS, Windows CE, TCP, UDP, IP, network protocols, traffic engineering, broadband equipment, IETF, IEEE, ITU standards)	6%

Each percentage value represents the percentage of the total number of job listings reviewed within each category (management and technical).

Table 3. High ranking management and technical skills from job listings.

these example lists are not exhaustive, they do provide an indication of the types of skills demanded within each career track.

Fit-Gap Analysis

A fit-gap analysis was performed to identify industry needs that are being met by the e-business curricula and those industry demands that are not covered. These "fits" and

"gaps" are discussed in terms of the two general categories of job types—management and technical.

Management skills. The job listings we reviewed suggest that there is a high demand in industry for consultants who have knowledge of how to integrate Web-based applications with enterprise resource planning (ERP), customer relationship management (CRM), supply chain management (SCM), and enterprise application integration (EAI) (10% of all job listings). However, the analysis of e-commerce courses offered by the leading graduate and undergraduate business programs, suggests several potential gaps in these areas. First, only 5% of the e-business courses in our sample cover the topic of SCM. Second, we found only two courses that focus primarily on ERP. Although CRM is often discussed as part of general marketing courses, we found no courses that focus on CRM in a Web context. Finally, we found no courses on EAI.

The data from our sample also indicate a relatively high demand for project management and analysis skills (14% of listings). Correspondingly, in the e-commerce programs we evaluated, there is a relatively high emphasis on e-business management and development skills (11%). This is also supported by the emphasis on e-business technology (5%). Therefore, we conclude that the programs in the sample have responded to these specific needs, resulting in a good fit between industry needs and e-commerce course offerings.

The last two top categories of demand are *vertical industry specialization* and *marketing management*. With regard to vertical industry specialization (4% of all job postings), we found very few e-commerce programs offering courses specifically targeted to this demand. Therefore, we conclude that a significant gap exists here. On the other hand, demand for marketing specialists (4%) appears to be well met by the large number of courses offered in the marketing area (17.5%, the largest single e-commerce course category).

Technical skills. In the technical area, we found a high demand for advanced programming skills in ERP, SCM, and EAI (such as Web Logix, MS Site Server, EDI, CrossWorlds) (12%). However, as mentioned earlier, there are only a small number of courses offered in SCM (5%), very few in ERP (0.5%), and no courses on EAI. The demand for networking specialists in e-commerce, on the other hand, seems to be relatively well met, with most e-commerce programs placing a strong emphasis on networking (9.5%). Also, the fact that data communications is covered in most IS programs suggests that there is a good fit between industry demand in this area and courses provided by the universities in our sample.

The job listings also show a high demand for Web administration (12%) and Web programming (9%). As Table 3 shows, these areas have some overlap (that is, knowledge of Web development tools such as Java, ASP, COM/DCOM). In addition, Web administration positions require strong knowledge of UNIX and Windows-based environments. Based on the analysis of course offerings, we find a relatively strong emphasis (6%) on Web development and programming tools. However, it seems that few e-commerce programs offer training in specialized tools and technologies (like DCOM, CORBA, SOAP).

Finally, the results suggest that there is a relatively high demand for knowledge of wireless technologies and wireless protocols for mobile computing (6%). Unfortunately, very few programs we reviewed offer courses in mobile computing, perhaps because the field is still relatively new and evolving.

The fit-gap analysis leads to several conclusions regarding the gaps between e-commerce courses offered in leading universities and industry demand: there is a growing demand in industry for ERP-Web integration. However, few academic programs have addressed this particular issue; very few programs focus on vertical industry specializations (such as financial services, health care) in the e-business curriculum; even though mobile business is growing in importance, currently, there is little emphasis on the issue of managing e-business for mobile users [10]. Potential issues here include: development of mobile e-commerce interfaces, creating and implementing new technologies for mobile computing, security and reliability of mobile e-commerce applications, and integration of mobile computing with ERP; and few academic programs offer courses in e-business architecture, even though many job positions rely heavily on knowledge of how to set up and maintain the physical and application infrastructure for an e-business.

Bridging the Gaps

Based on these gaps between e-commerce curricula and industry demand, we provide the following six recommendations.

Increase training in specialized software applications. E-commerce programs need to place greater emphasis on SCM, ERP, and EAI. A major component of the move in this direction would be to provide more specialized tool training (for example, using ERP software as an integral component of classroom instruction). In the past, two significant barriers to doing this have been that technologies change quickly, and the costs to educational programs for implementing training in specific software applications have been sizeable—both in terms of steep learning curves and financial costs of acquiring and maintaining the software. One way to reduce these costs to universities, and to make current versions of software more readily available, would be for universities to partner with software manufactures to create training programs for faculty, and for manufacturers to provide software to universities at reasonable costs (such as via educational incentives). Universities would benefit by creating courses more relevant to industry and student needs, and industry would benefit from hiring graduates that are more fully prepared to meet their needs. In addition, software manufacturers may benefit by creating a greater awareness of, and potentially wider market for, their products.

Integrate e-commerce into traditional business courses. Business programs need to produce more graduates who are skilled in functional areas such as healthcare, telecommunications or finance, *and* at the same time are knowledgeable about e-business [11]. Firms in our sample demand increasing numbers of individuals who have these skills. Often, it is simply not feasible for them to train new employees in a specific functional area or in e-business once they join the workforce. A solution to this problem may be to integrate e-business into traditional business majors. This may require professors in these traditional disciplines to retool by integrating e-business into their core knowledge base. This is in line with the latest developments in industry. Instead of having e-business as a separate functional area, organizations and firms are now incorporating and integrating e-business into their traditional business functions.

Embrace wireless technologies. The wireless industry is booming, and many business organizations are responding by exploring ways to integrate wireless technologies into their standard business practices. However, it seems that e-commerce programs

have yet to respond to this demand. Currently, there are very few courses on mobile-business and m-business applications. How can we narrow this gap? One approach may be, again, to encourage partnerships between industry and academia, with industry playing the vital role of guiding and directing the content and focus of m-business courses. We believe there are two ways to do this: industry can work with universities to jointly determine the content, areas of emphasis, and outcomes of courses in m-business; industry could provide training and software to incorporate into university courses—the primary outcome would be to render it less costly for universities to upgrade skills and software on an ongoing basis.

As part of the need to promote m-business, we believe that it is also important to explore issues of improving interface design for mobile devices [10]. Usability cannot be overemphasized. Simply stated, if m-business is to become the wave of the future, as many have suggested, devices must be usable "on-the-move". Issues of how to present information to mobile users and to discover ways of interacting that are accessible to all users is a significant challenge in e-commerce. Courses need to be developed that explore these very important topics.

Emphasize training in e-business security. The growth and proliferation of e-commerce for all types of applications, and in a variety of contexts (both stationary and mobile) demand that we focus on developing new ways to insure that data and transactions are as safe as possible, and that we respect the privacy of individuals [12]. By implementing courses in e-commerce curricula that address security and privacy issues, we can begin to make this a priority.

Managing e-business in a global environment. More e-commerce programs should emphasize the change management issues involving e-commerce in an increasingly global environment. In particular, new courses should focus on issues confronted by many public and private organizations (such as cross-border commerce, product delivery, trust, international monetary issues, government regulations, e-government, supply chain integration, and cross-cultural differences.)

Remain current in e-commerce technologies. Finally, e-commerce technologies are constantly changing. For example, a significant advancement in Web design and use in recent years has been the concept of the semantic Web [2]. Using XML to provide syntax and structure, the semantic Web attempts to create an environment in which data can be shared and processed by automated tools, as well as by users. It is challenging, but important, to equip e-commerce graduates with knowledge of these latest technologies—particularly for those e-commerce programs emphasizing the technology track.

By increasing their focus on these issues and continually updating their curricula, we believe that universities can continue to narrow the gaps between skills provided in their e-commerce programs and courses and the needs of business and industry.

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