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THE MARKET PRESENCE OF IT APPLICATIONS

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ABSTRACT

Information technology (IT) offers an ever expanding array of uses in modern business and, as such, management at all levels is focused on the implementation of IT applications. In order to examine the current state of the market presence of IT applications, a survey of companies in North America was conducted to assess the implementation levels of their IT applications. Based on the results of the survey, this paper documents a set of benchmarks that show the current status of the IT applications market presence of both: conventional information systems and enterprise information systems.

Keywords: IT application market presence, IT systems implementation, IT infrastructure

INTRODUCTION

Since the early 1950s computers have been employed to facilitate business activities. Originally information technology (IT), a term coined by Leavitt and Whisler [3], was utilized to automate manual systems for basic business functions, such as payroll, accounting, and inventory. These applications, involving the routine processing of data from repetitive, high-volume transactions, were labeled transaction processing systems and became the staple of early IT applications. In the 1960s, management information systems were developed to summarize and report data from production transaction files for management support. As computer technology advanced, offering new possibilities, additional applications were developed, such as decision support, expert systems, electronic retailing, and supply chain management. For over two decades it has been recognized that, in addition to supporting existing business processes, organizations now use IT applications to improve productivity, enhance performance, and reduce costs [4], to enable new ways of planning, organizing, and controlling [1], to create new business opportunities and gain competitive advantage [8], to improve customer service, boost product and service quality, and to integrate supplier and customer activities [5].

Given the myriad uses and wide-ranging potential of IT, management at all levels, both within and outside the IT department, is interested in the extent to which IT applications are implemented within their organizations. Since each type of application in the portfolio has a cost, the perceived value of an application to a business can be judged by the extent of its implementation [9]. As such, applications implementation has often been cited as a key issue for management [6]. In order to shed light on

the current state of the market presence of IT applications, we conducted a survey of companies in the United States and Canada to assess the implementation levels of their IT applications. This paper presents the results of that survey and, as such, provides a data-based set of benchmarks for the status of the market presence of IT applications.

SURVEY FINDINGS

Our survey was sent to 800 randomly selected computer executives in large and medium-sized North American companies. The questionnaire listed IT applications in two categories (conventional systems and enterprise systems) and asked the respondents to indicate the extent to which their organization had implemented these systems, on a seven-point scale (1 = None . . . 7 = Very Great Extent).

After two mailings, we received 202 survey forms back (92 from U.S. companies and 110 from Canadian companies), representing a 25% response rate. Two-thirds of the respondents reported that their companies had annual revenues of greater than $250 million, and 59% reported at least 1000 employees in their firms. The respondent's companies represented multiple industries, including banking, financial, insurance, health services, manufacturing, wholesale, retail, utilities, communications, and transportation. The majority of companies (43.6%) were listed as manufacturing; the next closest category was financial/banking/insurance (16.3%), followed by health services (8.9%).

CONVENTIONAL SYSTEMS

The data on conventional systems are reported in Tables 1 through 1c. Each table shows the mean implementation rating of the application, on the seven-point scale, as well as the percentage of companies that have implemented the application at least to some extent (a rating of four or greater on the seven-point scale). Implementation results for all respondents to the survey are reported in Table 1.

Table 1: Extent of Implementation of Conventional Systems

Application	Average Rating (1=None . . . 7=Very Great)	Implemented at Least to Some Extent
TPS	6.06	96.5%
MIS	5.06	87.9%
Data Warehouse	4.03	62.7%
DSS	3.38	50.5%
EIS	3.35	47.8%
KM	2.74	32.9%
Data Mining	2.73	32.8%
Expert System	2.01	17.5%

As can be seen, transaction processing systems (TPS) have been implemented more than any other type of application, with an average rating of 6.06 (out of 7) indicating a high level of the extent of TPS implementation. Almost all companies in the sample (96.5%) had implemented TPS at least to some extent. Of course, the fact that TPS are implemented the most is not surprising, because TPS are the oldest type of IT application and these systems form the foundation for other applications in most organizations. Management information systems (MIS) were implemented a bit less than TPS, with 87.9% of the sample companies having implemented MIS at least to some extent. Again, given that MIS are historically the second type of system to be implemented and naturally follow TPS, this finding is expected.

And, as might be expected, applications aimed at narrower audiences were not implemented to the extent of TPS and MIS. Decision support systems (DSS) and executive information systems (EIS) were each implemented at least to some extent by about half of the companies in the sample. Knowledge management (KM) applications had been implemented even less than DSS and EIS, with only about one third of the reporting companies indicating that KM applications were implemented at least to some extent. The type of conventional application implemented the least was expert systems. These systems were rated as being minimally implemented, with only 17.5% of the

companies having implemented expert systems at least to some extent. This finding is understandable due to the very specialized nature and limited applicability of expert systems.

Data warehousing, a relatively new application, was a focus for many companies in the survey, with nearly two-thirds reporting at least some amount of data warehouse implementation. The data warehouse application ranked third behind TPS and MIS in terms of the extent of implementation, even though the older application types have a much longer track record. Clearly, data warehousing is an application that is receiving growing interest, and because data warehouses are typically broad based, containing data from most functional areas of the firm, it seems likely that a data warehouse will join TPS and MIS as a core IT application.

Data mining, an application even younger than data warehousing, but often associated with a data warehouse, had yet to be extensively deployed; only about a third of the companies had implemented a data mining application at least to some extent. As the availability of large amounts of data in data warehouses becomes more common place, the emphasis on data mining will likely increase. This study expands to examine the data for whether there is a difference between United States vs. Canadian companies, Manufacturing vs. Service Industries, smallest and largest companies, and correlations of the extent of Implementations among eight types of applications.

United States vs. Canada Differences

Compared to the U.S, the extent of the conventional system applications implementation among the respondent's firms is lower in Canada for all eight types of applications. The mean for the extent of the applications implementation in Canada is in the range between the "Close to None" with 1.69 and "Somewhat More Than Average" scales with 5.81 while that of the U.S. is in the range between "Less Than Average" with 2.41 and "Great" scales with 6.36. The results are presented in Table 1a.

Table 1a: Extent of Implementation of Conventional Systems: United States vs. Canada

	United States		Canada		Tests of Differences	
Application	Average Rating (1=None . . . 7=Very Great)	Implemented at Least to Some Extent	Average Rating (1=None . . . 7=Very Great)	Implemented at Least to Some Extent	t Statistic	Alpha
TPS	6.36	98.9%	5.81	94.5%	3.55*	.001
MIS	5.26	91.1%	4.90	85.2%	1.74	.083
Data Warehouse	4.47	70.5%	3.66	56.2%	2.92*	.004
DSS	3.61	53.8%	3.21	48.0%	1.44	.153
EIS	3.58	55.4%	3.15	41.4%	1.54	.126
KM	2.99	37.8%	2.55	29.0%	1.53	.129
Data Mining	3.31	46.9%	2.24	20.8%	3.81*	.001
Expert System	2.41	26.3%	1.69	10.5%	2.84*	.005

* Statistically Significant at least at the .05 level

Manufacturing vs. Service Industry Differences

Except TPS the extent of the conventional system applications implementation among the respondent's firms is almost the same level in both industries for all seven types of applications. The mean for the extent of the TPS implementation in the service industry is "Great" with 6.22 while that of the manufacturing is "More than Average" with 5.84. The results are presented in Table 1b.

Table 1b: Extent of Implementation of Conventional Systems: Manufacturing vs. Service

Application	Manufacturing		Service		Tests of Differences	
	Average Rating (1=None . . . 7=Very Great)	Implemented at Least to Some Extent	Average Rating (1=None . . . 7=Very Great)	Implemented at Least to Some Extent	t Statistic	Alpha
TPS	5.84	95.3%	6.22	97.3%	2.34*	.021
MIS	4.97	89.7%	5.14	86.5%	0.81	.517
Data Warehouse	3.93	66.7%	4.10	59.6%	0.61	.540
DSS	3.44	51.9%	3.34	49.5%	0.38	.704
EIS	3.40	48.2%	3.30	47.5%	0.34	.736
KM	2.72	32.9%	2.76	33.0%	0.12	.905
Data Mining	2.45	26.3%	2.94	37.6%	1.74	.084
Expert System	2.06	19.2%	1.97	16.1%	0.38	.702

* Statistically Significant at least at the .05 level

Smallest vs. Largest Firm Differences

As expected the extent of the conventional system applications implementation among the smallest firms is lower for all eight types of applications. The mean for the extent of the applications implementation among the smallest firms is in the range between the "Close to None" with 1.62 and "Somewhat More Than Average" scales with 5.82 while that of the largest firms is in the range between "Less Than Average" with 2.17 and "Great" scales with 6.25. The results are presented in Table 1c.

Table 1c: Extent of Implementation of Conventional Systems: Smallest vs. Largest Companies

Application	Small		Large		Tests of Differences	
	Average Rating (1=None . . . 7=Very Great)	Implemented at Least to Some Extent	Average Rating (1=None . . . 7=Very Great)	Implemented at Least to Some Extent	t Statistic	Alpha
TPS	5.82	90.9%	6.25	99.2%	1.81	.077
MIS	4.56	79.4%	5.26	90.7%	1.95	.058
Data Warehouse	2.91	39.4%	4.54	71.8%	4.20*	.001
DSS	2.94	39.4%	3.63	58.3%	1.72	.091
EIS	3.23	50.0%	3.46	50.0%	0.53	.597
KM	2.50	23.3%	2.86	37.4%	0.93	.358
Data Mining	2.13	25.0%	3.10	38.1%	2.61*	.012
Expert System	1.62	10.3%	2.17	20.4%	1.77	.083

* Statistically Significant at least at the .05 level

Correlations of the Extent of Implementations among Eight Types of Applications

The results indicate TPS lacks correlations with DSS, EIS, KM, Data Mining and Expert System applications. However, all other seven types of applications have a high level of correlations with other applications. The results are presented in Table 2.

Table 2: Correlations of the Extent of Implementation among Conventional Systems

Application	TPS	MIS	DW	DSS	EIS	KM	DM
MIS	.216*						
Data Warehouse	.237*	.488*					
DSS	.120	.456*	.466*				
EIS	.035	.368*	.363*	.590*			
KM	.005	.308*	.508*	.495*	.444*		
Data Mining	.178	.373*	.661*	.470*	.377*	.656*	
Expert System	.018	.236*	.324*	.423*	.426*	.509*	.470*

* Statistically Significant at least at the .05 level

ENTERPRISE SYSTEMS

Enterprise systems provide support for fundamental firm-wide processes, spanning internal and external organizational boundaries, and usually include the capabilities of TPS, MIS and possibly other types of conventional systems. Oliver [7] noted that in today's business environment it would be unthinkable to manage a firm's financial, employee, customer, manufacturing, and supplier activities without an enterprise system. An enterprise resource planning (ERP) system, which is one type of enterprise system, is typically an off-the-shelf software package consisting of multiple, separate but integrated, modules each addressing a common business function. Similarly, Jones and Young [2] suggested that ERP modules support all or most functional areas in an organization. On our survey questionnaire, we asked the respondents to report on ten individual ERP modules: financial accounting, investment management, asset management, human resource, plant maintenance, quality management, sales and distribution, material management, production planning, and work flow. In addition, we included three other enterprise systems on the questionnaire as standalone applications: customer relationship management (CRM), sales force automation (SFA), and supply chain management (SCM). The survey results for these enterprise systems are provided in Tables 3, 3a, 3b, 3c, and 4; the ERP modules are all listed first, followed by the standalone systems at the bottom of the table.

As can be seen from Table 3, which reports the implementation results for all respondents to the survey combined, a good deal of ERP implementation was present. However, this was largely confined to five areas. The financial accounting module enjoyed the greatest amount of implementation, with 84.1% of the firms indicating that this subsystem was implemented at least to some extent. The human resource and asset management modules were implemented at least to some extent by slightly more or less than 60% of the companies, respectively. The material management and sales and distribution modules were implemented at least to some extent by approximately 50% of the companies. The other five ERP modules (work flow, quality management, production planning, plant maintenance, and investment management) were implemented considerably less, with roughly only about a third of the companies indicating that these modules were implemented at least to some extent. ERP systems have been the subject of considerable interest over the last decade, due in some degree to the rush to address the Y2K problem.

Table 3: Enterprise Systems

Application	Average Rating (1=None . . . 7=Very Great)	Implemented at Least to Some Extent
ERP Financial Accounting Module	5.31	84.1%
ERP Human Resource Module	4.33	64.5%
ERP Asset Management Module	3.86	57.9%
ERP Material Management Module	3.54	48.1%
ERP Sales and Distribution Module	3.50	50.9%
ERP Work Flow Module	2.88	36.8%
ERP Quality Management Module	2.76	34.9%
ERP Production Planning Module	2.72	37.0%
ERP Plant Maintenance Module	2.66	36.3%
ERP Investment Management Module	2.39	28.5%
Customer Relationship Management	2.93	38.1%
Supply Chain Management	2.92	39.9%
Sales Force Automation	2.81	36.1%

The extent of implementation of the three stand-alone enterprise systems (CRM, SCM and SFA) was just somewhat greater than minimal, with slightly less than 40% of the companies indicating that they had implemented these systems at least to some extent. The fact that SCM and CRM, in particular, were not implemented more is surprising, since these systems have been touted as key strategic applications. This study further examines the data for whether there is a difference between United States vs. Canadian companies, Manufacturing vs. Service Industries, smallest and largest companies, and correlations of the extent of Implementations among eight types of applications.

United States vs. Canada Differences

Compared to the U.S, the extent of the enterprise system applications implementation among the respondent's firms is lower in Canada for all four types of enterprise system applications. The mean for the extent of the applications implementation in Canada is in the range between the "Close to None" with 1.88 and "Slightly More Than Average" scales with 4.96 while that of the U.S. is in the range between "Close to Average" with 3.17 and "More Than Average" scales with 5.72. Specifically among eight ERP modules, compared to the U.S, the extent of the implementation among the respondent's firms is lower in Canada for all 10 types of modules. The mean for the extent of the 10 module implementation in Canada is in the range between the "Close to None" with 1.88 and "Average" scales with 4.99 while that of the U.S. is in the range between "More Than Average" with 2.58 and "Great" scales with 5.72. The results are presented in Table 3a.

Table 3a: Extent of Implementation of Enterprise Systems: United States vs. Canada

Application	United States		Canada		Tests of Differences	
	Average Rating (1=None . . . 7=Very Great)	Implemented at Least to Some Extent	Average Rating (1=None . . . 7=Very Great)	Implemented at Least to Some Extent	t Statistic	Alpha
ERP Financial Accounting Module	5.72	87.2%	4.96	81.6%	2.72*	.007
ERP Human Resource Module	4.98	78.2%	3.76	52.5%	3.83*	.001
ERP Asset Management Module	4.46	69.0%	3.32	47.9%	3.61*	.001
ERP Material Management Module	4.26	64.4%	2.89	33.3%	3.51*	.001
ERP Sales and Distribution Module	3.96	61.0%	3.08	41.9%	2.33*	.021
ERP Work Flow Module	3.51	49.4%	2.31	25.6%	3.75*	.001
ERP Quality Management Module	3.62	56.3%	2.00	16.0%	5.09*	.001
ERP Production Planning Module	3.65	58.0%	1.88	18.2%	5.12*	.001
ERP Plant Maintenance Module	3.50	54.4%	1.92	20.5%	4.66*	.001
ERP Investment Management Module	2.58	30.4%	2.23	26.8%	1.01	.315
Customer Relationship Management	3.36	46.7%	2.55	30.6%	2.51*	.013
Supply Chain Management	3.89	60.3%	1.97	20.0%	5.95*	.001
Sales Force Automation	3.17	44.4%	2.51	29.1%	2.02*	.045

* Statistically Significant at least at the .05 level

Manufacturing vs. Service Industry Differences

The extent of the enterprise system applications implementation among the respondent's firms is similar in the manufacturing firms for all four types of enterprise system applications than that of the service firms. The mean for the extent of the module implementation in the manufacturing is in the range between the "Minimal" with 2.22 and "More Than Average" scales with 5.48 while that of the service firms is in the range between "Minimal" with 2.01 and "More Than Average" scales with 5.17. Among eight ERP modules, compared to the manufacturing firms, the extent of the implementation among the respondent's firms is lower in the service firms for all 10

types of modules. The mean for the extent of the 10 module implementation in the manufacturing ones is in the range between the "minimal" with 2.22 and "More Than Average" scales with 5.48 while that of the service ones is in the range between "Minimal" with 2.01 and "More than Average" scales with 5.17. The results are presented in Table 3b.

Table 3b: Extent of Implementation of Enterprise Systems: Manufacturing vs. Service

Application	Manufacturing		Service		Tests of Differences	
	Average Rating (1=None . . . 7=Very Great)	Implemented at Least to Some Extent	Average Rating (1=None . . . 7=Very Great)	Implemented at Least to Some Extent	t Statistic	Alpha
ERP Financial Accounting Module	5.48	89.3%	5.17	80.0%	1.08	.284
ERP Human Resource Module	4.22	58.5%	4.41	69.2%	0.58	.564
ERP Asset Management Module	3.99	63.8%	3.76	53.1%	0.70	.483
ERP Material Management Module	4.25	61.6%	2.9	35.8%	3.42*	.001
ERP Sales and Distribution Module	4.26	65.8%	2.83	37.9%	3.89*	.001
ERP Work Flow Module	2.96	40.0%	2.81	34.1%	0.47	.640
ERP Quality Management Module	3.11	41.4%	2.45	29.3%	1.94	.054
ERP Production Planning Module	3.44	54.2%	2.01	20.3%	4.07*	.001
ERP Plant Maintenance Module	2.94	44.3%	2.39	28.9%	1.54	.126
ERP Investment Management Module	2.22	26.5%	2.53	30.1%	0.90	.370
Customer Relationship Management	3.15	42.5%	2.75	34.5%	1.24	.218
Supply Chain Management	3.01	42.3%	2.83	37.7%	0.51	.609
Sales Force Automation	3.04	37.3%	2.60	34.9%	1.35	.178

* Statistically Significant at least at the .05 level

Smallest vs. Largest Firm Differences

The extent of the enterprise system applications implementation among the smallest firms is much lower for all four types of applications. The mean for the extent of the applications implementation among the smallest firms is in the range between the "Close to None" with 1.81 and "Average" scales with 4.63 while that of the largest firms is in the range between "Less Than Average" with 2.29 and "More than Average" scales with 5.59. The results are presented in Table 3c.

Table 3c: Extent of Implementation of Enterprise Systems: Smallest vs. Largest Companies

	Small		Large		Tests of Differences	
Application	Average Rating (1=None . . . 7=Very Great)	Implemented at Least to Some Extent	Average Rating (1=None . . . 7=Very Great)	Implemented at Least to Some Extent	t Statistic	Alpha
ERP Financial Accounting Module	4.63	70.0%	5.59	89.7%	2.07*	.045
ERP Human Resource Module	3.32	45.2%	4.71	73.0%	2.96*	.005
ERP Asset Management Module	2.89	35.7%	4.29	66.7%	3.07*	.004
ERP Material Management Module	2.70	29.6%	3.94	57.0%	2.36*	.023
ERP Sales and Distribution Module	3.00	39.3%	3.83	58.6%	1.54	.132
ERP Work Flow Module	2.53	26.7%	3.19	42.9%	1.50	.141
ERP Quality Management Module	1.81	14.8%	3.16	45.6%	3.64*	.001
ERP Production Planning Module	2.0	25.0%	3.05	41.9%	2.52*	.014
ERP Plant Maintenance Module	2.23	26.9%	2.99	44.3%	1.56	.127
ERP Investment Management Module	2.68	35.7%	2.29	25.8%	o.78	.443
Customer Relationship Management	2.46	21.4%	3.17	44.9%	1.71	.094
Supply Chain Management	2.04	18.5%	3.47	52.2%	3.56*	.001
Sales Force Automation	2.37	25.9%	3.13	43.3%	1.83	.074

* Statistically Significant at least at the .05 level

Correlations of the Extent of Implementations among Four Types of Applications

Unlike The correlations among convention system applications, all other four types of applications have a high level of correlations with other applications. The highest correlations are between SCM and SFA applications, and ERP Production and quality management modules. The results are presented in Table 4.

Table 4. Correlations of the Extent of Implementation among Enterprise Systems

Application	FA	HR	AM	MM	S&D	WF	QM	PP	PM	IM	CRM	SCM
HM	.555*											
AM	.593*	.578*										
MM	.461*	.367*	.372*									
S&D	.463*	.337*	.417*	.549*								
WF	.386*	.466*	.428*	.381*	.357*							
QM	.288*	.402*	.360*	.490*	.342*	.420*						
PP	.357*	.381*	.337*	.596*	.528*	.529*	.668*					
PM	.309*	.492*	.395*	.541*	.364*	.402*	.485*	.581*				
IM	.205	.374*	.322*	.099	.249*	.462*	.239	.238	.307*			
CRM	.248*	.282*	.278*	.138	.358*	.328*	.221	.216	.162	.250		
SCM	.370*	.403*	.420*	.500*	.459*	.432*	.549*	.520*	.446*	.333*	.356*	
SFA	.240*	.290*	.277*	.198	.471*	.466*	.270*	.297*	.294*	.317*	.638*	.480*

* Statistically Significant at least at the .05 level

Note: FA: Financial Account, HR: Human Resource, AM: Asset Management, MM: Material Management, S&D: Sales & Distribution, WF: Work Flow, QM: Quality Management, PP: Production Planning, PM: Plant Maintenance, IM: Investment Management, SFA: Sales Force Automation

U.S. vs. Canadian differences in the Manufacturing Industry

We were also interested in the differences in the market presence of IT applications between companies in the United States and Canada within each industry sector. However, with the exception of manufacturing, we did not feel that we had large enough sample subsets to conduct a cross-country analysis. Consequently, we examined the differences in the average extent that each type of application was implemented in the manufacturing firms between the two countries.

Compared to the U.S, the extent of the implementation among the manufacturing firms is lower in Canada for all two categories. The mean for the extent of conventional system applications implementation in Canada is in the range between the "Close to None" with 1.71 and "Somewhat More Than Average" scales with 5.72 while that of the U.S. is in the range between "Less Than Average" with 2.66 and "Great Extent" scales with 6.07. Especially, the mean for the extent of ERP, SFA, CRM, and SCM applications implementation in Canada is in the range between the "Minimal" with 2.18 and "Somewhat More Than Average" scales with 5.26 while that of the U.S. is in the range between "Less Than Average" with 2.46 and "More Than Average" scales with 5.87. The results are presented in Table 5.

Table 5: Country Differences in Applications Presence in the Manufacturing Industry

Application	United States Average Extent Implemented	Canada Average Extent Implemented	Tests of Differences t Statistic	Alpha
TPS	6.07	5.72	1.34	.184
MIS	5.29	4.79	1.70	.093
Data Warehouse	4.30	3.72	1.49	.142
DSS	3.71	3.30	.98	.332
EIS	3.61	3.27	.85	.400
KM	2.86	2.65	.51	.613
Data Mining	2.82	2.23	1.39	.169
Expert System	2.66	1.71	2.19*	.034
ERP Financial Accounting Module	5.87	5.26	1.65	.103
ERP Material Management Module	5.29	3.60	3.21*	.002
ERP Human Resource Module	5.23	3.63	3.45*	.001
ERP Production Planning Module	4.93	2.44	5.35*	.001
ERP Sales and Distribution Module	4.76	3.96	1.53	.129
ERP Quality Management Module	4.69	2.18	5.66	.001
ERP Asset Management Module	4.66	3.61	2.21*	.030
ERP Plant Maintenance Module	4.54	2.00	5.52*	.001
Supply Chain Management	4.21	2.19	4.56*	.001
Customer Relationship Management	3.68	2.82	1.76	.084
ERP Work Flow Module	3.57	2.60	2.16*	.035
Sales Force Automation	3.34	2.85	1.02	.310
ERP Investment Management Module	2.46	2.25	.66	.515

* Statistically Significant at least at the .05 level

CONCLUSIONS

In a large sense the results of this investigation confirm the conventional wisdom about the market presence of IT systems, albeit from the basis of empirical data. Broad-based, traditional applications, such as TPS, MIS, and the ERP accounting and human resource modules, are the systems that have been implemented the most. Applications with a more focused user base, but having been around for a while, including DSS, EIS, and the material management and sales and distribution ERP modules, have been implemented a moderate amount. The bulk of the remaining applications, either due to their specialized nature or their newness, have only been implemented at a fairly minimal level.

The real action in the IT market has been on data warehouses. Although data warehousing is a relatively new application, the value of a data warehouse is clear and it is being implemented as a key component in many companies.

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