CRITICAL SUCCESS FACTORS OF GLOBAL ENTERPRISE RESOURCE PLANNING PROGRAMMES: AN EMPIRICAL MODEL BASED ON EXPERT INTERVIEWS

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Abstract

The number of companies operating globally is constantly increasing. In order for these companies to operate globally, they require a global view of processes and their implementation in global enterprise resource planning (ERP) systems. These ERP systems allow to integrate an organization's information sources and to harmonize its processes across multiple sites and countries.

But, not all global ERP programmes are successfully implemented. Some implementation projects fail in terms of classical project tracking, e.g. slippage of roll-out dates, budget overruns or missed qualitative objectives, while others fail more severely in their business impact, e.g. intended business benefits are not achieved including process standardization, process automation and asset carrying cost reduction.

To reduce the number of failed ERP programs, their critical success factors have been investigated but reports of these are not sufficiently comprehensive for global programmes as multi-national operations generate aspects that need to be addressed for success.

This study explores the critical success factors of global ERP programmes and derives a predictive model of success. Use of this model may aid companies in developing effective global ERP programmes.

Keywords: ERP, Critical Success Factors, Qualitative Research, Global.

1 Introduction

Many companies of various sizes must decide the extent and means by which to support worldwide activities through globally-harmonized processes and systems. Sankar & Rau (2006) describe an example of a typical multi-national Enterprise Resource Planning (ERP) implementation based on a case study. They points out that "one of the key success factors for an ERP system in a company is how it is implemented (Sankar & Rau, 2006, p. 90)". These ERP implementations are hereafter referred to as *ERP projects*. But "ERP implementation impacts people, systems and the organisation as a whole (Sankar & Rau, 2006, p. 82)". To reflect the wider view of organisational changes the term *ERP programme* is used hereafter. Therefore while ERP projects are focussed on outputs (as a functioning ERP system) ERP programmes are focussed on outcomes (as a change in how the organisation operates).

A detailed review of whether to implement an ERP system, categorization of the types of benefits to be expected and the guidelines in selection of ERP consultants, software and hardware vendors can be found in Davenport (2000).

This study contributes to the research question of which factors are critical for the success (CSF) of global (in the sense of multinational and multicultural as outlined in Hofstede (1984)) ERP programmes distinguished by the types of benefits.

2 Literature Review

In general, Critical Success Factors (CSF) for implementing ERP programmes have been broadly analysed in the literature. Aspects of change management are always part of ERP implementations and have been investigated repeatedly. For example, Hossain *et al.* (2002) propagate the use of the "myth of integration", i.e. the vision of an integrated enterprise as the driver for change (Hossain *et al.*, 2002, p. 17ff). Other resource related aspects mentioned repeatedly are management attention and personnel. The views in methodology vary, but the importance of the subject is clearly confirmed. Table 1 provides an overview of identified CSF categorized as methodological, resource-related and environmental. These categories have been chosen for practical considerations to enable management decisions: methodological factors define *how* to implement, resource-related factors define *with which* resources to implement, and environmental factors define *who* implements (i.e. under what environment the company operates). These categories were chosen according to the initial understanding as outlined in the section 'Initial Understanding' (see Figure 1) based on case study research.

Reference	Research Method	Methodological	Resource-related	Environmental	Comments
Burns & Turnipseed (1991)	Mail survey	Use of a written implementation plan, extent of hardware modification, multi-facility integration, source of software	Use of project team, percentage of project manager time devoted to implementation, consultant use and involvement	Product technology, organization willingness, prior systems environment, prior record-keeping formalization and accuracy, prior management-control formalization	Explicit separation of environmental and methodological factors (not matching this assessment), focus on material resource planning (a predecessor of ERP)

Bingi, Sharma & Godla (1999)	Not stated	Reengineering, integration, training employees	Top management commitment, ERP consultants and vendors, selecting the right employees, implementation time and costs	Employee morale	Purely a descriptive review of CSF without a specific research method stated
Holland & Light (1999) / Holland & Light (2003)	Case study	Business vision, ERP strategy, project schedule and plans, business process change and software configuration, communication, monitoring and feedback, troubleshooting	Top management support, client consultation, personnel	Legacy systems, client acceptance	Both papers communicate the same content to different audiences; Factors grouped into strategic and tactical; interplay of factor groups outlines
Nah *et al.* (2001)	Literature	Project management, business plan and vision, business process engineering and minimum customization, change management programme and culture, effective communication, software development testing and troubleshooting, monitoring and evaluation of performance	Project champion, top management support, ERP teamwork and composition	Appropriate business and IT legacy systems	Mapped onto programme phases
Somers & Nelson (2001)	Survey	Clear goals and objectives, project management, management of expectations, careful package selection, data analysis and conversion, user training on software, education on new business processes, business process reengineering, minimal customization, architecture choices, change management, interdepartmental communication	Top management support, project team competence, project champion, vendor support, dedicated resources, use of steering committee, partnership with vendor, use of vendors' tools, use of consultants	Interdepartmental cooperation	Separated by implementation phases: initiation, adoption, adaptation, acceptance, routinization, and infusion
Akkermans & van Helden (2002)	Case study	Clear goals and objectives, project management, management of expectations, interdepartmental communication, careful package selection	Top management support, project team competence, project champion, vendor support	Interdepartmental cooperation	Explores interrelations between CSF
Hong & Kim (2002)	Survey	*Moderator variables:* ERP adaptation, process adaptation		Organizational fit	Only one CSF is analysed and the impact of moderator variables onto this CSF estimated

Al-Mashari, Al-Mudimigh & Zairi (2003)	Literature	Visioning & planning, ERP package selection, communication, process management, project management, training & education, system integration, system testing, performance evaluation and management	Management & leadership	Legacy system management, cultural and social changes	Embedded in a phase model of setting-up, implementation and evaluation, evaluated against ERP success and benefits
Parr & Shanks (2003)	Case Study	Deliverable dates, vanilla ERP, smaller scope, definition of scope and goals, commitment to change	Management support, best people full time, empowered decision maker, champion, balanced team		Applicability of CSF was probed for the different phases of the lifecycle of an ERP programme based on a self defined lifecycle model
Sarker & Lee (2003)	Case study	Open and honest communication *(falsified)*	Strong and committed leadership, a balanced and empowered implementation team *(falsified)*		Two of the three CSF as *necessary* preconditions have been falsified
Sumner (2003)	Case study	Failure to re-design business processes, failure to follow an enterprise-wide design which supports data integration, failure to adhere to standardized specifications which the software supports, lack of integration	Insufficient training and re-skilling, insufficient internal expertise, lack of business analysts with business and technology knowledge, lack of ability to recruit and retain qualified ERP system developer	Inability to avoid technological bottlenecks	Identifies *risk factors* rather than CSF and verifies their *uniqueness to ERP*
Loh & Koh (2004)	Literature Interviews	Same as Nah *et al.* (2001)	Same as Nah *et al.* (2001)		Confirmed the CSF of Nah *et al.* (2001) with one exception based on wider literature review, verified for Small Enterprises
Nah & Delegado (2006)	Case study	Business plan and vision, change management, project management, system analysis, selection and technical implementation, communication	ERP team composition, skills and compensation, top management support and championship		Mapped onto programme phases, focused on upgrade projects
Soja & Put (2007)	Survey	ERP system with full functionality		Company industry, large enterprises	CSF and company attributes were related via a cluster analysis

Table 1. Review of CSF in literature

While the CSF list in the literature is extensive, it generally does not consider multi-national or global (terms used interchangeable) aspects of ERP implementation. However, a few papers have been dedicated to this subject. Huang & Palvia (2001) introduce a research framework to compare ERP

deployment in developed and developing countries. Multi-national ERP implementation practices were shown to be affected by national differences, identified as culture and language, government/corporate politics, management style, government regulations, time zone and labour skills (Sheu, Yen & Krumwiede, 2003). The relationship between ERP implementation and a firm's competitive strategy has also been investigated and national culture and government/corporate policies, in particular, were found to have a significant impact on ERP deployment (Yen & Sheu, 2004). The framework of Somers & Nelson (2001) was partially verified based on two longitudinal case studies of international ERP programmes in Plant & Willcocks (2007). Soh, Kien & Tay-Yap (2000) (further elaborated by Kien & Soh (2003)) investigate misfits of ERP functionality typically based on European or U.S. industry practices and requirements of Asian users on the base of hospital ERP programmes. Davison (2002) discusses the cultural context embodying organisational practices and its implications for Hong-Kong ERP implementations. Krumbholz & Maiden (2001) define a model of organisational and national culture based on multi-cultural research and subsequently applied it to a a Swedish SAP implementation project to "detect and model critical determinants of culture that influence problems with the implementation of ERP packages" (Krumbholz, Galliers & Maiden, 2003, p. 395f). In summary, the distinguishing aspects of global ERP programmes have been partially investigated, but no consolidated framework of Critical Success Factors in global ERP programmes has been devised.

3 Research Approach and Data Analysis Process

To generate CSF for global ERP programmes this study was conducted following the principles of grounded theory outlined in Böhm (2000, p. 476ff). This study aims to develop a theory based on empirical data gathered on CSF for global ERP programmes and entails qualitative research as it is based on expert opinions.

To distinguish the results from a simple collection of experience-based success factors, the study strictly followed a set of quality criteria for qualitative research published by Steinke (2000). It stipulates the necessity of inter-subjective traceability of the research process, i.e. while the results of the study cannot be replicated as it is based on interviews, the process must be clearly documented to be traceable. In particular, it requires documentation of "the initial understanding of the researcher", "the method and context of data gathering", "the transcription rules", the "data analysis process" and the "sources of information (Steinke, 2000, p. 323ff, translation by the authors)". Each aspect is described in detail in the following sub-sections.

3.1 Initial Understanding

The researchers developed an initial understanding of Critical Success Factors for global ERP programmes based on case study research, as shown in Figure 1. This primarily served as a means to design the study and, in particular, the interview guide. As the study followed an exploratory approach, it was not intended to be proven or rejected.

ERP programme success was initially defined in terms of on-time, in-budget and in-scope project delivery. The key aspects relevant to the success of global ERP programmes were considered to be grouped into environmental, resource-related and methodological success drivers.

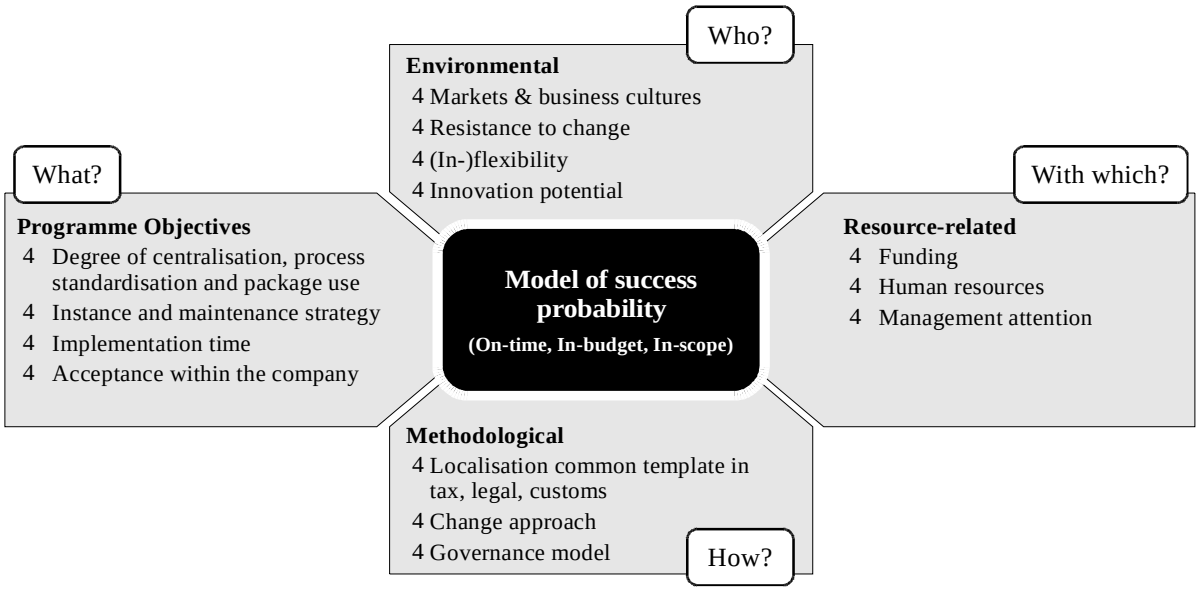


Figure 1. Initial definition of success and its relevant drivers

3.2 Method and Context of Data Gathering

Data gathering was conducted via a series of expert interviews of chief information officers and project managers from global ERP programmes. The objective of the interviews was to identify the Critical Success Factors of specific global ERP programmes and to review them considering the specific company situation and design decisions made.

According to Merkens (2000), exploratory studies are generally not able to define the sample *a priori*, as the full theory is yet to be discovered in the data (Merkens, 2000, p. 294). Therefore, it requires a theoretical sampling approach, whereby, after analysing the data from an initial number of cases, the need for further inquiry is defined. According to Strauss & Corbin (1967) this process has to be repeated until a theoretical saturation is reached, *i.e.* no further improvement of the theory can be obtained by further cases. In the case of this study the state of saturation was deemed reached once all success factors under consideration were established without contradiction and the last interview did not add to the understanding.

Interviews were based on an interview guide, designed to investigate and obtain the following five elements: (1) company overview; (2) overview of the global ERP programme; (3) design choices; (4) Critical Success Factors; and (5) definition of success. The interview guide was originally designed in German and tested in a first interview before finalization. The final version was translated into English with the help of a native English speaker. The questionnaire is accessible at http://www.gunter-seidel.de/phd/Fragebogen_v2b2_engl.pdf

Interviews were conducted in part by telephone and in person. The latter form of face-to-face interview was always used when the interview partner had not previously met the interviewer. The interviews were recorded upon permission by the interview partners. This permission was repeated at the beginning of the recording to have it as a verbal record. The recordings were transcribed and transcripts were provided to the interviewees for review. The review cycle served to validate the information obtained as well as to mitigate resistance to the tape recording. Additional comments were captured in the review phase and added separately to the material.

3.3 Transcription

Interview recordings were transcribed following a set of rules. According to Kowal & O'Connell (2000) "only the aspects of the interview that will be analysed should be transcribed (Kowal & O'Connell, 2000, p. 444, translation by the author)". Therefore, the rules are focused on anonymous literal transcription. Formal details of the transcription rules as an indication of speaker, punctuation, or marking of incomprehensible parts were based on Kuckartz *et al.* (2007, p. 27f) and amended according to the author's experience and needs. The majority of interviews were conducted in German, and, according to Strauss & Corbin (1998, p. 285f), were not translated into English as the author was German-speaking; some interviews that were conducted in English are available for outside non-German speaking reviewers.

3.4 Data Analysis Process

The transcriptions were coded in a first stage according to the initial understanding of relevant aspects as outlined in the section 'Initial Understanding' (see Figure 1), which had already been used to design the interview guide. It thereby uses the theoretical initial understanding, as recommended previously (Schmidt, 2000, p.447), to guide the analysis. In this case, the initial understanding served as a means to structure and analyse the codes, and was not meant to be the model to be confirmed. Therefore, extensive use was made of free nodes (i.e. to be categorized nodes used interim) to record all new findings which did not fit the model. In a second stage the nodes derived from initial understanding and use of free nodes were reviewed one by one to decide whether sufficient evidence existed to support, group or reject them. Due to practical constraints of availability of only one researcher no comparison of the coding of different researchers could be conducted.

Material from the interviews was collected with the help of a software tool for qualitative research (Nvivo 7 from QSR International). The type of software was chosen to improve efficiency, reinforce systematic use of research techniques and liberate researchers from tiring mechanical tasks allowing them to focus on the creative aspects of interpreting the data (Kelle, 2000, p. 499f). The latter aspect was particularly appreciated by the author during the analysis. This software allowed for cross-referencing of the interview data therefore allowing the evidence across all interviews to be read and analysed based on each aspect of the referred model. This cross-interview analysis enabled rejection of aspects with insufficient evidence, grouping of elements of unnecessary granularity, and adding of new aspects and relationships by analysing the free nodes.

3.5 Sources of Information

Data gathering by expert interviews targeted organizations with a global ERP programme to generate results representative of worldwide developments. These programmes spanned multiple continents or at least multiple countries of different languages, *i.e.* programmes in exclusively German- or English-speaking region were not considered. The choice of industries was arbitrary, and, in line with initial views, almost no industry-specific references were made in the interviews. Whereas the data does not allow generalization across all industries, the results do not imply industry dependency. As many current medium-size enterprises have a global path, a mixture of medium and large enterprises was deliberately chosen. Interview partners from these organizations were people responsible for an end-to-end perspective of the entire program; no technical personnel or team leaders were interviewed.

A total of 13 interviews were conducted and the interview series was concluded when the researchers deemed to have reached a theoretical saturation as outlined in 'Method and Context of Data Gathering'. Interview partners included four chief information officers, two consultants, and seven project managers (including one who was also an application manager) from global ERP Programmes. Project Managers were included as they usually have a sound understanding of the programme they are contributing to. The heterogeneous choice of interviewees was intentional to juxtapose position

specific views as the unit of analysis is the programme. The interviewees came from a range of industries such as automotive, nutrition, insurance, and chemical and industrial products. While some of the programmes were in the early stages of ERP advancement, such as design and template development, the majority were in mature stages of operation. These interview partners were chosen for heterogeneity across the before mentioned attributes. In addition, the consulting arm of an ERP package software vendor and a hardware vendor were interviewed towards the end of the series to contrast their multi-programme views with the views of the end customers of ERP systems. These interviews focused only on Critical Success Factors, as they were not based on any specific ERP deployment. An anonymous list of all interviews can be found in Table 2.

Key	Position	Industry	Lifecycle	Main Project Location	Em-ployees
A	Project Manager	Nutrition	Late roll-out cycle	Germany	40.000
B	Project Manager	Automotive	Mature operation	Italy	10.000
C	Chief Information Officer	Chemical products	Blueprint phase	Germany	4.000
D	Application Manager	Industrial products	Mature operation	Switzerland	3.000
E	Chief Information Officer	Insurance	Post pilot	Switzerland	20.000
F	Consultant	HW-vendor	n/a	n/a	n/a
G	Project Manager	Industrial products	Late roll-out cycle	Germany	4.000
H	Consultant	ERP-SW-vendor	n/a	n/a	n/a
I	Chief Information Officer	Chemical products	Mature operation	Switzerland	20.000
J	Project Manager	Insurance	Late roll-out cycle	Switzerland	60.000
K	Chief Information Officer	Industrial products	Mature operation	Germany	10.000
L	Project Manager	Automotive	Blueprint phase	Italy	20.000
M	Project Manager	Paper	Late roll-out cycle	Germany	40.000

Table 2. List of expert interviews

4 Results

This section describes the definition of success, which was found to be broader than initially assumed, in the ERP programs investigated in this study. Moreover, it describes the top Critical Success Factors that were generally accepted across all interviews. These factors are separated into common factors universally-set for the programme, and local factors applicable for each site. The local factors indicate deviations of the site roll-out success compared to the central programme and, to estimate the success of the overall program, all sites must be aggregated and added to the common factors.

4.1 Definitions of Success

Early interviews indicated that the initial view of ERP programme success was rather short-sighted as it mixed programme and project success. There were examples of global ERP programmes fully successful in terms of the criteria considered – which are common project success indicators, and, therefore, renamed 'Project Objectives' – but which did not realize all intended business benefits. Therefore, the model was extended by business-driven factors under the heading 'Programme Objectives'.

These programme objectives were either clearly quantifiable savings in terms of IT costs, process costs or directly associated reductions to specific business expenditures such as stock-carrying costs. On the other hand, a number of indirectly quantifiable long-term business benefits were mentioned such as risk reduction, auditability, adherence to standards and improved competitiveness. These were company-specific and grouped under the heading 'Business Improvements'.

The importance of the project objectives varies from programme to programme. Generally an on-time introduction was considered important, as it is highly visible in the organization and directly drives costs. On the other hand, the traditional trade-off between quality and time was mentioned in the interviews. While in-budget programme completion is desirable, many programmes had multiple budget revisions due to the long timeframe of implementation and the constantly changing conditions during the roll-outs. While in-scope has many company-specific definitions, one common theme was the avoidance of business interruptions during go-live, and functioning maintenance and support.

4.2 Common Critical Success Factors

Critical Success Factors were identified as outlined in the section 'Analysis ' and grouped into common and site-specific Critical Success Factors. The former are common to all ERP programmes and influenced the programme outcomes of each site.

CSF	Description	Management Actions
Change Management Approach	Company has an effective approach to handle the organizational changes induced by the ERP roll-out.	- Change management is local - Change management is formal - Vision established for new business models - Communication is effective - End-to-end view trained - Technical and organizational concepts are aligned
Management Attention	All levels of management have been aligned towards the ERP programme.	- Top management sponsorship established and - engaged throughout life cycle - Middle management buy-in generated
Funding Model	Funding model chosen supports efficient and effective ERP implementation.	- Aligned to programme approach - Generates incentive for roll-out - Generates cost-effective requirements - Ensures efficient project operation
Human Resources	Human resources are adequately provided to the ERP programme to fulfil its tasks.	- Top process skills available - Intercultural know-how available - Joined business and IT, global and local teams - Team stability is ensured - Team can interact face-to-face - Team is full-time - External resources are well managed
Governance Model	A stringent governance model is established to manage the ERP programme.	- Efficient scope change management - Governance board to handle mgmt. effectively - Programme management established - Stable objectives - Plans sustain of global ERP
Method Selection	Selection and execution of a method for design, deploy-ment and localization.	- Follows a method consistently - Blueprint is comprehensive - Method is made company specific
Tools	Early deployment of suitable tools.	- Selected early - Suitable to drive efficiency
Technical Factors	All technical challenges are addressed.	- All technical challenges are addressed: Compliance, data conversion, master data, security, unicode, availability, time zones, translation, infrastructure

Table 3 Common success factors

All such factors from the initial understanding prevailed during the course of the research, but were operationalized by a number of management actions driving them. All of these actions were verified by more than one interview partner and are one of the key outcomes of the interview series providing the necessary detail and support for the Critical Success Factors. The list of these indicators can be found in Table 3.

During the research process, two new groupings of Critical Success Factors were identified: the deployment of adequate tools and the sufficient consideration of technical factors. Both were common to the ERP programmes investigated, and have therefore been added to the table of common Critical Success Factors.

4.3 Site-specific Critical Success Factors

A number of Critical Success Factors are site-specific. These influence the programme outcomes for each site individually and must be aggregated over all sites to estimate their impact on the overall programme.

Some factors from the initial understanding had to be discarded as no or conflicting evidence was found; others were added during the analysis. All these factors were also operationalized. Table 4 summarizes the site-specific factors.

CSF	Description	Management Actions
Market and Business Cultures	Impact of the local market and business culture has been handled adequately.	- Local process requirements addressed - Intercultural work aspect handled
Unwillingness to Change	Initial level of resistance to a change of the site and the measures addressing it.	- Initial level is low - Handled adequately
Inability to Change	Limitations in the ability of people to embrace the changes.	- Language abilities - Innovation potential - Inflexibility
Necessary preconditions	Site is suitable for a roll-out.	- Suitable size & business model - Technology life cycle - Resource availability

Table 4 Site-specific success factors

5 Conclusions and Directions for Future Research

Based on 13 interviews with experts responsible for global ERP programmes a list of global and site specific Critical Success Factors has been derived. The experts came from companies of medium and large size from various industries.

The overall influences of the model of Critical Success Factors (Change Management Approach, Funding Model, Human Resources, Governance Model, Method Selection, Tools and Technical Factors) were mostly aligned to previously conducted research on ERP in general as investigated in a literature review at the beginning of this study. Interestingly, Tools and Technical Factors are generally not considered to be a technical challenge, but rather timely addressing of these issues is considered crucial. The remaining common factors are of a managerial nature as well, with a stronger emphasis on cross-cultural aspects driven by the global programmes.

What distinguishes this research is a number of site specific factors that have been identified as Critical Success Factors for global ERP programmes. First, these represent the challenges of country specific local process requirements and inter-cultural work aspects that must be addressed. Second, the factors of unwillingness and inability to change were importantly differentiated; while these factors seem very similar in their results, they must be distinctly addressed. Finally, due to the nature of global ERP programmes, on a site level success is driven by the site specific Necessary Preconditions of technology life cycle, available resources, and suitability in size and business models.

While the model derived by this research has identified and classified the Critical Success Factors of global ERP programmes, it has not yet verified their relationships on a statistically-relevant sample, nor quantified the relative extent to which these factors have an influence on the success. Therefore, a logical next research step is this verification based on structural equation modelling.

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