

A Respecification and Extension of the DeLone and McLean Model of IS Success

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DeLone and McLean's (1992) comprehensive review of different information system success measures concludes with a model of "temporal and causal" interdependencies between their six categories of IS Success. After working with this model for some years, it has become apparent that the inclusion of both variance and process interpretations in their model leads to so many potentially confusing meanings that the value of the model is diminished. Because of the confusion that this overloading of meanings can cause, this paper presents and justifies a respecified and slightly extended version of DeLone and McLean's model.

(*IS Success; IS Use; IS Evaluation; IS Effectiveness*)

1. Introduction

DeLone and McLean's (1992) comprehensive review of different information system success measures makes two important contributions to our understanding of Information System (IS) success. First, it provides a scheme for classifying the multitude of IS success measures that have been used in the literature, into six categories. Second, it suggests a model of "temporal and causal" interdependencies between these categories (1992, p. 83), as shown in Figure 1a. DeLone and McLean (henceforth D&M) conclude their paper with the comment that the model in Figure 1a "clearly needs further development and validation before it could serve as a basis for the selection of appropriate I/S (success) measures" (1992, p. 88).¹

Motivated by DeLone and McLean's call for further development and validation of their model, Seddon and Kiew (1994) tested part of D&M's model. They assumed that the causal model implied by D&M's paper was as shown in Figure 1b, and tested relationships among the four variables in the dotted-line box at the left of Figure 1b. After replacing *Use* by *Useful-*

ness and adding a new variable called *User Involvement* (as defined by Barki and Hartwick (1989)) results from their path analysis of data from 102 individual users of a university accounting system were as shown in Figure 2. More recently, Fraser and Salter (1995) replicated Seddon and Kiew's (1994) study, with very similar results.

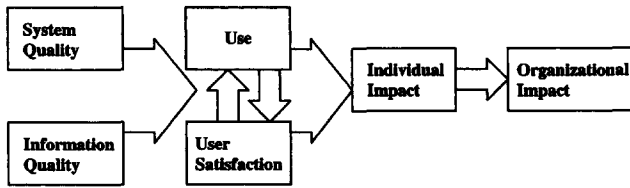
On the basis of the highly significant path coefficients in the both Seddon and Kiew (1994) and Fraser and Salter (1995), it is tempting to conclude that, at least for individual users of individual applications, there is substantial support for D&M's model of IS Success. However, the purpose of this paper is to suggest that D&M tried to do too much in their model, and that as a result, it is both confusing and misspecified.

The problem is that D&M attempted to combine both process and causal explanations of IS Success in their model. This they make clear in the following quotation, in which they discuss Figure 1a in this paper (their Figure 2):

"Figure 2 presents an I/S success model which recognizes success as a process construct which must include both temporal and causal influences in determining I/S success. In Figure 2, the six I/S success categories first presented in Figure 1 are rearranged to suggest an interdependent success construct

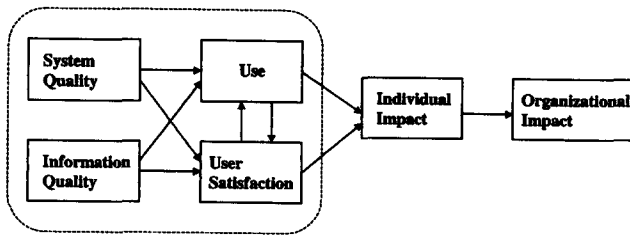
¹ As an indicator of the importance of D&M's March 1992 paper, it was cited by six of 32 papers in the ICIS 1994 Proceedings, and three papers in the ICIS 1995 Proceedings (p. 179, 309, 355).

Figure 1a DeLone and McLean's Model of IS Success*



* Reprinted by Permission, "Information Systems Success: The Quest for the Dependent Variable," W. H. DeLone and E. R. McLean, *Information Systems Research*, Volume 3, Number 1, 1992, page 87. Copyright 1992, The Institute of Management Sciences (currently INFORMS), 2 Charles Street, Suite 300, Providence, Rhode Island 02904 USA.

Figure 1b Path Model that Seems to be Implied by DeLone and McLean's Model (Seddon and Kiew 1994)



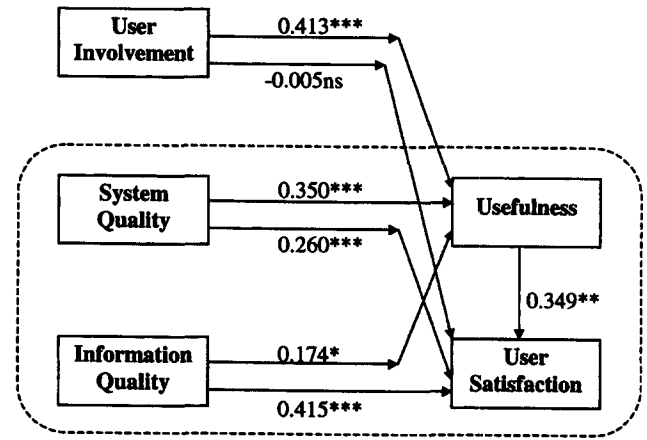
while maintaining the serial, temporal dimension of information flow and impact" (1992, p. 83) (underlining added).²

Figure 3, based on Newman and Robey's (1992) Figure 1, is helpful in explaining the difficulties this causes. Using the terminology in Figure 3, Figures 1b and 2 in this paper are variance models. They can be tested empirically by collecting data from a sample of cases, measuring variables, and using statistical techniques (e.g., ordinary least squares regression, PLS, and LISREL) to make inferences about populations. Variance models assert that for some population of interest, if all other things are equal, variance in any one of the independent variables is necessary and sufficient to cause variance in the dependent variables.

By contrast, process models show how certain combinations of events, in a particular sequence, cause certain outcomes. Each event in the process is necessary,

² Except in the above quotation which (necessarily) uses D&M's type-setting conventions, variables in this paper are *italicized*, and text is underlined for emphasis.

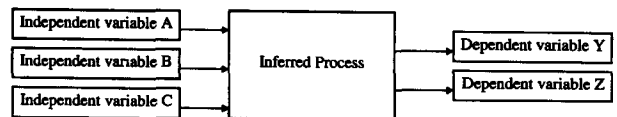
Figure 2 Results of Path Analysis, n = 102* (User Involvement is as Defined by Barki and Hartwick (1989).)



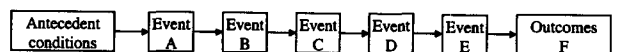
Note: Significance Levels: ***p < 0.001, **p < 0.01, *p < 0.05.

Figure 3 Variance and Process Models Compared*

(a) Variance model



(b) Process model



Based on "A Social Process Model of User-Analyst Relationships," M. Newman and D. Robey, *MIS Quarterly*, Volume 16, Number 2, 1992, page 252. Copyright 1992

but not sufficient, to cause the outcome.³ Mohr (1982) argues that transmission of malaria is a good example of a process model. In this process, (A) a person with malaria is bitten by a mosquito; (B) malaria parasites breed in the mosquito's stomach; (C) after a few weeks' growth, their progeny enter the saliva of the mosquito; (D) when the mosquito bites someone, saliva containing young parasites is transmitted to that person; (E) in the next fortnight or so, the young parasites grow to

³ An example of process modeling research in IS is the paper by Sabherwal and Robey (1993). This analyzes sequences of events (e.g., assignment of personnel, submission of proposal, approval, etc.) in 53 IS implementation projects and uses cluster analysis to identify "six distinct types of implementation processes."

maturity in the new victim; and (F) the new victim develops malaria.⁴ Note that being bitten by a mosquito does not, in itself, cause malaria; it is the chance combination of events (A) and (D), in that sequence, that matters.

Both Mohr (1982) and Newman and Robey (1992, p. 251) go to some pains to explain that the boxes and arrows in variance- and process-model diagrams represent quite different concepts and cannot be combined meaningfully in the one model. For instance, in the above mosquitoes-causing-malaria example, Event C does not cause Event D. The arrow between Event C and Event D in the process model tells us that if Events A, B, and C have already happened, and Event D happens, then Events E and F will almost inevitably follow. Since the boxes in a process model represent discrete have-happened/have-not-happened events, and the arrows indicate sequence, not causality, it is not possible to adopt a variance model interpretation of one part of a box-and-arrow diagram, and a process model interpretation of another part. If one does, there must be a slippage of meanings somewhere in between.

Unfortunately, combining variance and process models is exactly what D&M attempted to do. The result is that many of the boxes and arrows in D&M's model (Figure 1a) can, and do, have both a variance and an event-in-a-process interpretation. The problem is that the same human perceptual limitations that enabled Dutch artist, M. C. Escher (1982)⁵ to produce paradoxical drawings of stairways that seem at one moment to be going up, and at another to be going down (because our minds can only make sense of small parts of his drawings at a time) mean that when a reader looks at D&M's model, his/her efforts to make sense of different parts of the model will frequently cause slippage from one meaning for a box or arrow to another. The result is a level of muddled thinking that is likely to be counter-productive for future IS research.

⁴ A much more complete account of this process is available in Zucker's (1996) WWW page.

⁵ To see the image of Escher's *Relativiteit* (1953), go to http://www.cultech.yorku.ca/art/escher_5.html. (This page is mirrored on <http://www.dis.unimelb.edu.au/staff/peter/escher.htm>.)

In an effort to overcome the above difficulties, this paper presents a respecified and slightly extended version of D&M's model of IS Success. The respecified model retains most of the features of the D&M model, but eliminates the confusion caused by the multiple alternative meanings for the boxes and arrows. It does so by splitting D&M's model into two variance submodels (of Use and Success) and eliminating the process model interpretation of D&M's model.

2. The Three Meanings for "IS Use" in DeLone and McLean's Model

The major difficulties with D&M's model can be demonstrated by focusing on the *Use* box in Figure 1a. Here, it is possible to identify three possible meanings for *Use*.

Meaning 1: IS Use as a Variable that Proxies for the Benefits from Use. When the first possible meaning of *IS Use* is uppermost in the reader's mind, *Use* acts as a variable that proxies for the benefits from use. This is exactly what one would expect in a model of IS Success, but even here there are problems. The intuition behind the benefits-from-use-as-success interpretation of *Use* can be found in Lucas's (1975) observation that unused systems are failures. Since the opposite of failure is success, it is frequently assumed that heavily used systems are successes. However, as Szajna (1993) has pointed out, this assumption is not necessarily correct. The critical factor for IS Success measurement is not system use, but that net benefits should flow from use. Lucas's systems were failures, not because they were not used, but because they provided no benefits (a consequence of non-use). A successful system will provide benefits such as helping the user do more or better work in the same time, or to take less time⁶ to achieve as much work of the same quality as was done in the past. The many authors in the past⁷ who have used *IS Use* as an indicator of IS Success were implicitly assuming a positive (often linear) relationship between time spent using a system and the benefits it provides.

⁶ Note that if less time is the desired goal, IS Use measured in hours is *inversely* correlated with IS Success.

⁷ For example, the 27 studies in D&M's table 3 (1992: 70-71), who measured *IS Use* in hours and/or frequency of use and/or extent of use.

Meaning 2: IS Use as the Dependent Variable in a Variance Model of Future IS Use. When the second meaning of *IS Use* is uppermost in the reader's mind, he/she interprets the arrows from the three constructs *System Quality*, *Information Quality*, and *User Satisfaction* in Figure 1a as parts of a variance model with *future IS Use* as the dependent variable.⁸ When viewed in this way, D&M's model competes with the work of Davis et al. (1989), Davis (1989, 1993), Adams et al. (1992), Segars and Grover (1993), Thompson et al. (1991, 1994), and Moore and Benbasat (1991) as a possible model for explaining *future use* of information technology. The important point to note about this second possible meaning of *IS Use* is that in this role *IS Use* is being used to describe behavior; it is not being used as a measure of IS Success.⁹ Now, since D&M's model is intended to interrelate categories of IS Success measure, this second meaning is clearly not a valid interpretation of *Use* in D&M's model. In other words, Meaning 2 *IS Use* has no place in D&M's model of *IS Success*.

Meaning 3: IS Use as an Event in a Process Leading to Individual or Organizational Impact. The third possible interpretation for *IS Use* that may at some times be uppermost in the reader's mind, is that *User Satisfaction*, *Individual Impact*, and *Organizational Impact* are outcomes of a process that begins with *IS Use*.¹⁰ It seems to be for this reason that the arrows in Figure 1a lead from *Use* down to *User Satisfaction*, and right to *Individual Impact* then *Organizational Impact*.¹¹ As with the second meaning of *IS Use*, the important point to note is that under this view of *Use*, *Use* itself is not being treated as a measure of IS Success; it is the *User*

Satisfaction, *Individual Impact*, and/or *Organizational Impacts* (if any), the consequences of *Use*, that are observed to determine if the system is successful. Again, therefore, this third meaning of *IS Use* has no place in any variance model of interrelationships between *IS Success* measures.

The surprising conclusion that follows from the above analysis is that the only valid meaning for *IS Use* in a variance model of *IS Success* (and all of D&M's measures in their Tables 1–6 are variance-model measures) is Meaning 1. Here, for voluntary use, of similar systems, by similarly skilled users, measures of *IS Use* (such as hours of use and frequency of use) can act as proxies for *Benefits from Use*.

3. D&M's Model Is Really a Combination of Three Different Models

To make the last point more forcefully, and to emphasize what the variables in D&M's model actually measure, Figure 1a has been redrawn in Figure 4 with the words "Benefits from Use" placed in front of each of the four right-hand classes of variable.¹² D&M's relationships between these variables have also been drawn as dotted lines to emphasize that when *IS Use* has this restricted meaning, the meanings of all the relationships between the variables need to be reexamined.

Redrawing D&M's model this way has two consequences. First, it becomes clear that the four success-construct categories on the right-hand side of D&M's model are just ways of classifying variables that attempt to measure benefits from use. Two of these variables, *IS Use* and *User Satisfaction*, have been used so often in the past that D&M have placed them in special classes. The other two are just convenient classifications of the remaining variables. Prima facie there is no reason for expecting any variance-model relationship between these four types of measure; they are just different ways of tapping into the one underlying construct, *Benefits from Use*.

¹² All the measures in D&M's tables are supposed to measure some aspect of *Benefits from Use*. Even variables such as "Time taken to complete a task" (in D&M's Table 5, p. 76) measure *Benefits from Use*, because what is actually of interest is the reduction in time taken.

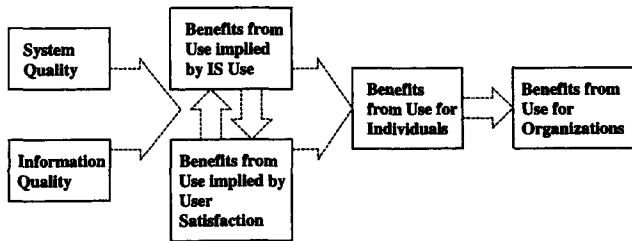
⁸ This is the meaning which D&M probably intended when they referred to "causal influences" in the quotation above.

⁹ Davis (1989), for instance is trying to predict whether his subjects will use computer technology in the future.

¹⁰ This is the meaning that D&M probably intended when they described IS Success "as a process construct" in which "temporal" influences affect I/S success, in the quotation above.

¹¹ In fact, it is hard to construct strong arguments to justify any other interpretation. How, for instance, can perceptions of *User Satisfaction* have an *Impact* on individuals or organizations? Although initial high expectations may lead to high actual outcomes, surely in the long run it is peoples' observations of the outcomes of use, the impacts, that determine their satisfaction with the system, not vice versa.

Figure 4 The Meaning of the Categories in DeLone and McLean's (1992) Model of IS Success



Second, the model in Figure 4 is much less interesting than D&M's model! Many of the Meaning 2 and 3 sub-stories that one can read into D&M's model, e.g., "the greater the level of *System Quality* or *User Satisfaction*, the greater the level of *Use* of the system," or "the more the system is used, the greater the *Individual Impact* (and ultimately *Organizational Impact*)," or "system *Use* must necessarily occur before one can expect to observe *User Satisfaction* or *Individual Impact*" are absent in Figure 4. All these substories rely on the Use-as-behavior or Use-as-one-step-in-a-process interpretations of *IS Use* that were shown above to be invalid in an IS Success model. In other words, the reason that D&M's model seems to say so much to the reader, is that it is actually a combination of three models:

- a variance model of IS Success, where the independent variables are probably *System Quality* and *Information Quality*, and the dependent variables are *IS Use* (as a Meaning 1 proxy for *Benefits from Use*) and *User Satisfaction*;
- a variance model of *IS Use* as a behavior (Meaning 2 for *IS Use*);
- a process model of IS Success, where *IS Use* is a Meaning 3 event that necessarily precedes outcomes such as *User Satisfaction*, *Individual Impact*, and *Organization Impact*.

4. The Respecified Model of IS Success (and Use)

In an effort to retain as much as possible of the richness of meanings in D&M's model, whilst at the same time avoiding the slippages in meaning that are likely to occur when one works with the ex-

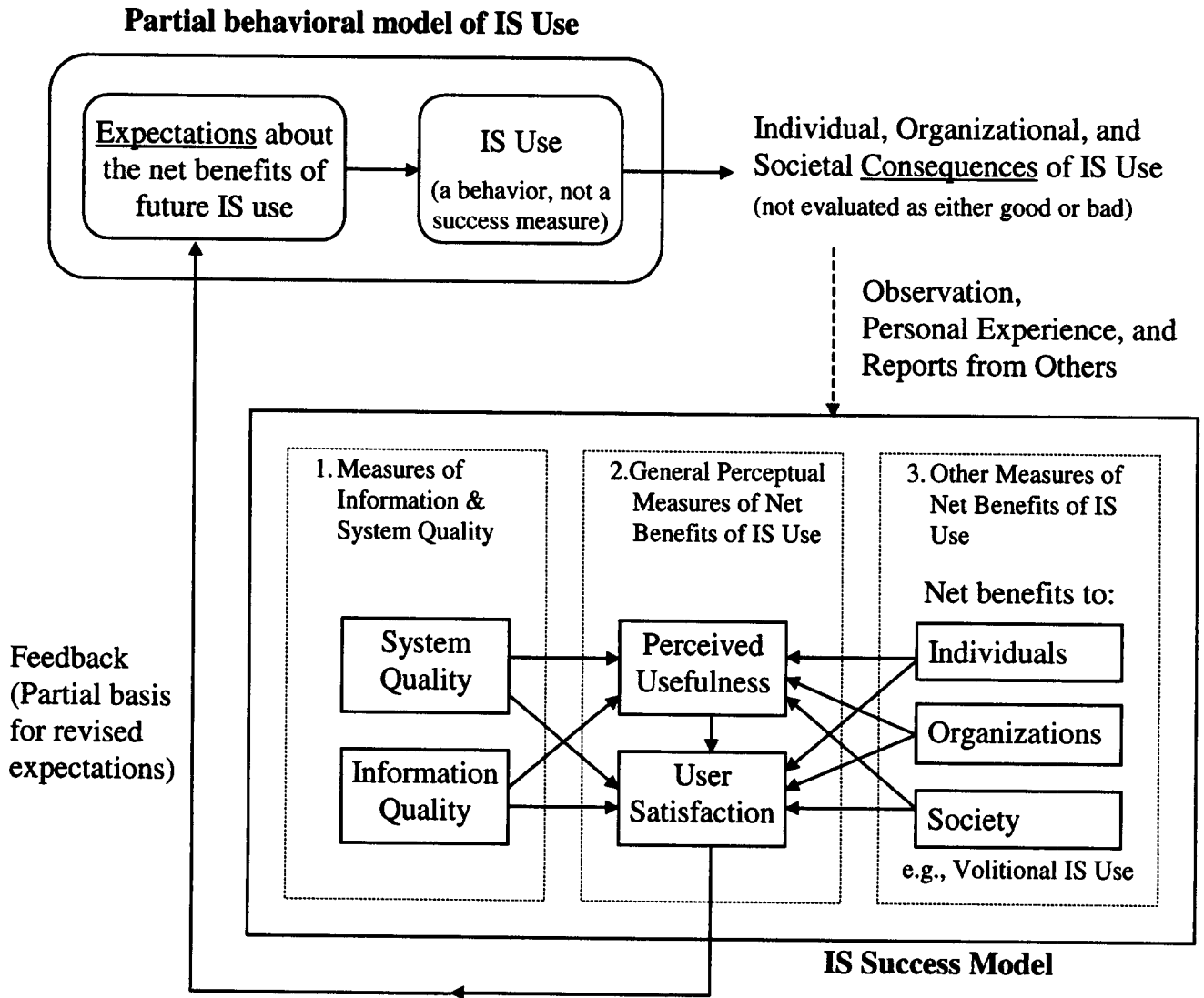
isting D&M model, their model has been redrawn in Figure 5. Figure 5 is the major contribution of this paper.

The concepts and variables used in Figure 5 are defined in Table 1. This table is intended to act as a single point of reference for clarifying what is meant by the model in Figure 5. For example, Figure 5 clearly assumes the existence of an information system of some kind, but it is not clear what "an information system" is. The entry in the first row of Table 1 is intended to answer that question by defining the systems of interest to be various types of applications of information technology (IT). Pitt et al. (1995) present their *Service Quality* measure as an extension of D&M's model. But under the definition of "system" in Table 1, their approach would be invalid because a firm's Information Systems (IS) department is not an "application of IT."¹³ One could, of course, broaden the definition of "information system" to include the IS department, but two key variables in D&M's model, *System Quality* and *Information Quality*, are not properties of an IS department. For this reason, the definitions in Table 1 exclude Pitt et al.'s interpretation of IS Success measurement.

In Figure 5, the process interpretation of D&M's model has been eliminated, and the remainder of their model has been split into the two distinct variance models that are implicit in Figure 1a. The first of these two variance models is the partial behavioral model of *IS Use* shown in the rounded box at the top left of the figure. Only a partial behavioral model is presented because the goal of this paper is to interpret and clarify D&M's model, not to extend it significantly. The second variance model is the IS Success model shown in the large rectangular box at the bottom of Figure 5. Finally, the two variance models in Figure 5 are linked through the path down from *Consequences of IS Use* to the IS Success model, and the feedback path from *User Satisfaction* (in the IS Success model) up to revised *Expectations about*

¹³ Pitt et al.'s use of *Service Quality* to measure the effectiveness of their IS departments is entirely appropriate. But measures such as *System Quality* and *Information Quality* in Figure 5 are attributes of applications, not of IS departments. This is why IS departments are not included in the definition in Table 1.

Figure 5 Respecified Version of DeLone and McLean's (1992) Model of IS Success (Constructs Defined in Table 1)



Key:

- Rectangular boxes
- Rounded boxes
- Solid-line arrows
- Dotted-line arrow

- IS Success model
- Partial behavioral model of IS Use
- Independent (necessary and sufficient) causality
- Influence (not causal, since observer's goals are unknown)

Table 1 Definition of Concepts and Variables Used in Figure 5

Concept/Variable	Definition
<i>Information System</i> (Implicit in the Model)	The “ <i>information system</i> ” of interest is either some aspect of an application of information technology (IT), one individual application, a group of applications (including those of an entire organization), or an application of one type of IT.
<i>Net Benefits</i>	<i>Net Benefits</i> is an idealized comprehensive measure of the sum of all past and expected future benefits, less all past and expected future costs, attributed to the use of an information technology application. Any use of resources (including time) in building, learning to use, and/or using the system is a cost. To measure <i>Net Benefits</i> , one has to adopt some stakeholder’s point of view about what is valuable and what is not.
<i>Expectations about the net benefits of future IS use</i>	As in any expectancy-theory model, e.g., Vroom (1964), <i>Expectations about the net benefits of future IS use</i> is a valence-weighted sum of the decision-maker’s expectations about the costs and benefits of future IS Use.
<i>IS Use</i>	<i>IS Use</i> means using the system. It is expected that resources such as human effort will be consumed as the system is used. <i>IS Use</i> might be measured in hands-on hours, hours spent analyzing reports, frequency of use, number of users, or simply as a binary variable: use/non-use.
<i>Individual, Organizational, and Societal Consequences of IS Use</i>	<i>Consequences</i> are intended to be value-neutral descriptions of outcomes attributed to <i>IS Use</i> . Even if they agree on the <i>Consequences</i> , different observers may value <i>Consequences</i> differently. Triandis (1980) uses the term “Objective Consequences” to describe a very similar concept.
<i>IS Success</i>	<i>IS Success</i> is a measure of the degree to which the person evaluating the system believes that the stakeholder (in whose interest the evaluation is being made) is better off. Logically, if <i>Net Benefits</i> could be measured with precision, <i>IS Success</i> would be equivalent to <i>Net Benefits</i> . However, <i>IS Success</i> also has political and emotive overtones of “we won” about it, which are less evident in <i>Net Benefits</i> .
<i>System Quality</i>	<i>System Quality</i> is concerned with whether or not there are “bugs” in the system, the consistency of the user interface, ease of use, quality of documentation, and sometimes, quality and maintainability of the program code.
<i>Information Quality</i>	<i>Information Quality</i> is concerned with such issues as the relevance, timeliness, and accuracy of information generated by an information system. Not all applications of IT involve the production of information for decision-making (e.g., a word processor does not actually produce information) so <i>Information Quality</i> is not a measure that can be applied to all systems.
<i>Perceived Usefulness</i>	<i>Perceived Usefulness</i> is a perceptual indicator of the degree to which the stakeholder believes that using a particular system <i>has</i> enhanced his or her job performance, or his or her group’s or organization’s performance. A system is useful if produces benefits. In judgments about <i>Perceived Usefulness</i> costs are much less important than benefits, so <i>Perceived Usefulness</i> is not the same concept as <i>Net Benefit</i> .
<i>User Satisfaction</i>	<i>User Satisfaction</i> is a subjective evaluation of the various <i>Consequences</i> (depicted in the top-right corner of Figure 5) evaluated on a pleasant-unpleasant continuum. Of all the measures in Figure 5, <i>User Satisfaction</i> is probably the closest in meaning to the ideal <i>Net Benefits</i> measure. UIS measures such as the Ives et al. (1983) instrument fall a long way short of the measuring this idealized construct.
<i>Net Benefits to Individuals, Organizations, and/or Society</i>	<i>Net Benefits</i> as perceived by these different types of stakeholder. <i>Organizations</i> includes both groups and management. Thus the four principal types of stakeholder (in whose interests IS effectiveness will be evaluated) are individuals, groups of individuals, management of organizations, and society. In general, measures important to one type of stakeholder are less likely to be important to the others.
<i>Volitional IS Use</i>	Unlike <i>Perceived Usefulness</i> and <i>User Satisfaction</i> , which are both perceptual measures, <i>Volitional IS Use</i> is an objective indicator that <i>Net Benefits</i> —as perceived by the person(s) who decides if the system will be used—exceed zero. In some circumstances, more <i>Volitional IS Use</i> may imply more benefits. In others, <i>Volitional IS Use</i> is just a binary indicator that net benefits are thought to be positive.

the net benefits of future Use (in the partial behavioral model). These two linkages are very similar to those in Triandis' (1980) model of interpersonal behavior.¹⁴ The remainder of this section explains the respecified model in more detail.

Starting at the top left of Figure 5, the behavioral variance model asserts that, all other things being equal, higher levels of *Expectations about the net benefits of future IS use* (henceforth *Expectations*) will lead to higher levels of (Meaning 2) *IS Use*.¹⁵ *Expectations* might be measured by an instrument such as Davis's (1989) *Perceived Usefulness*,¹⁶ or in money terms (if that were possible), or by some other special-purpose instrument. Example measures of *IS Use* are shown in Table 1.

The behavioral model in Figure 5 is intended to be consistent with the work of Davis et al. (1989), Davis (1989, 1993), Adams et al. (1992), Segars and Grover (1993), Thompson et al. (1991, 1994), Taylor and Todd (1995a, b), Moore and Benbasat (1991), and others who have used expectations-based frameworks to predict future *IS Use*. Through that literature, it is also intended to be consistent with the work of behavioral psychologists such as Fishbein and Ajzen (Fishbein and Ajzen 1975; Ajzen and Fishbein 1980; Ajzen 1985, 1991) and Triandis (1971, 1980), as well as Rogers' (1983) work on diffusion of innovations. In the case of mandatory use of a system by various members of an organization, it is the *Expectations* of senior management (for whom use is not mandatory) that determine *IS Use*, not the *Expectations* of their employees (who may prefer not to use it).

How does this *Expectations*-based behavioral model compare to the model implicit in D&M? As discussed previously under Meaning 2 for *IS Use*, D&M's model seems to imply that *System Quality*, *Information Quality*, and *User Satisfaction* are part of a causal variance model that predicts future *IS Use*. While this seems very plau-

sible, it is not the complete story. The problem is that no matter how good a system has been in the past, past benefit is not a sufficient condition for future use; future use must be based on *Expectations of future benefits*. For example, a person who has just replaced their word processing package with a new one may report that they liked their old system a lot, but they expect the new system to be even better. In this situation, favorable measures of *System Quality* or *User Satisfaction* (or any other success measures) relating to the old system are not sufficient to cause *Use* of the old system. Rather, potential users will use the system that they hope will offer them the highest net benefits in future. Thus in Figure 5, it is more correct to show *Expectations of net future benefits*, not the three variables in D&M's model, as the causal variable that drives *IS Use*.¹⁷

Moving clockwise in Figure 5, the consequences of *IS Use* are represented by the block of text labeled "Individual, Organizational, and Societal Consequences of *IS Use*" (henceforth *Consequences*). These *Consequences* are intended to be value-neutral¹⁸ descriptions of outcomes attributed to *IS Use*, not measures of *IS Success*. *Consequences* attributed to *IS Use* can include indirect outcomes. For example, if (1) use of a data warehouse enabled identification of a group of key products, then (2) price reductions on those key products were negotiated with their suppliers, then (3) in the months that followed there was a significant increase in gross margins on sales of those products, the increased profitability could reasonably be viewed as a *Consequence* of use of the data warehouse.

Note that *Consequences* are value-neutral outcomes attributed to *IS Use*, whereas the success measures in the box at the bottom of Figure 5 imply adoption of someone's point of view. To illustrate the difference, consider the *Consequences* of widespread use of the World Wide Web. One consequence of Web use is more freedom of access to all sorts of information. To many people this is a good thing. Yet to parents worried about children

¹⁴ The relevant variables in Triandis's (1980, Figure 1, p. 199) model are "Interpretations," "Objective Consequences," "Behavior," "Reinforcement," and "Consequences."

¹⁵ The "other things" that would need to be held equal would include factors such as subjective norm and perceived behavioral control, discussed in depth by Taylor and Todd (1995a, Figure 5, p. 163), and habit, as suggested by Triandis (1971, 1980).

¹⁶ *Perceived Usefulness* in Table 1 is a past-tense version of Davis's (1989) construct.

¹⁷ Of course, in the steady state, there is expected to be a strong positive association between *System Quality*, *Information Quality*, *User Satisfaction* and *Expectations*. This feedback relationship between D&M's three success variables and *Expectations* is discussed at the end of this section.

¹⁸ This term is used by Orlikowski and Baroudi (1991, p. 11) to describe positivist researchers' beliefs that they can detach themselves from the phenomena of interest.

stumbling across pornography, or to governments intent on censorship, this increased access to information is a bad thing. Similarly, with corporate information systems. Workers and managers may have different goals. Even if they agree on what the outcomes of system use are (the *Consequences*), they may draw different conclusions about the success of the system.

The arrow from *IS Use* to *Consequences* in Figure 5 represents the hypothesis that more *IS Use* implies more *Consequences*. This arrow appears similar in meaning to the *Use-Consequences* arrow in Silver et al.'s (1995) Information Technology Interaction Model (Figure 3, p. 366), but it is not clear whether Silver et al. intend more of a process- or variance-model interpretation of their arrow. In D&M's model (Figure 1a), the meaning of the arrows to the *Impacts* boxes is likewise unclear. Under the process model interpretation, *IS Use* is necessary but not sufficient to cause *Impacts* (you can't get malaria without being bitten by a mosquito, but not all mosquito bites cause malaria), whereas the variance model interpretation is that more *IS Use* is necessary and sufficient to cause more *Impacts*. The stronger, variance-model interpretation is specified in Figure 5.

The advantage of modeling *Consequences* explicitly in Figure 5 is that while it seems valid to hypothesize that more *Use* implies more *Consequences*, it is not necessarily true that more *Use* implies more *Net Benefits*. For example, for nonvolitional users more *Use* may mean more distress. Thus, in Figure 5, *Consequences* have been separated from *Net Benefits* (D&M's *Impacts*) to make it clear that IS Success measurement requires the adoption of someone's point of view. Without knowledge of that point of view, it is impossible to hypothesize relationships between *IS Use* and *IS Success*.

Moving clockwise again, the large rectangle at the bottom of Figure 5 contains the respecified model of IS Success. The idea behind this positioning of the IS Success model (the large rectangle) relative to the *Use* and *Consequences* variables at the top half of Figure 5 is that based on observation, personal experience, and reports from others about the *Consequences of IS Use*, the observer makes judgments about various aspects of what he/she regards as system success. IS Success is thus conceptualized as a value judgment made by an individual, from the point of view of some stakeholder.

The dotted vertical arrow from *Consequences* to *Success* indicates that there is no clear causal relationship from *Consequences* to *Success*. Perhaps if one could measure the importance of each *Consequence* to the stakeholder, and use the resulting importance measures to weight the scores for each *Consequence*, one might be able to calculate a weighted-sum-of-outcomes measure of IS Success. (A similar approach is used by Ajzen and Fishbein (1980) to compute attitudes from salient beliefs.) However, investigation of such detailed relationships would take us well beyond the scope of D&M's model. Figure 5 simply makes the very weak assertion that *Success* measures are thought to depend in some yet to be determined way on *Consequences*.

Stepping inside the large rectangle labeled "IS Success Model," we find a rather complex set of variance-model relationships between seven IS Success measures arranged in three columns. This IS Success model is the logical equivalent of Figure 4; all six of D&M's success measures appear here. *System Quality*, *Information Quality*, *User Satisfaction*, *Individual Impacts*, and *Organizational Impacts* are shown explicitly. *Use* appears as an example measure at the bottom of the *Other Benefits from Use* column (column 3) as "Volitional IS Use." In addition, two new variables, *Perceived Usefulness* and *Net Benefits to Society*, have been added to the model.

(a) *Measures of Information and System Quality* (column 1). The two variables in column 1 of the IS Success model are *System Quality* and *Information Quality*. These variables, defined in Table 1, are identical to D&M's two variables of the same names. In terms of relationships between these two variables, it is hypothesized in Figure 5 that *System Quality* and *Information Quality* are independent variables. For example, if the designer gets the specifications wrong, a technically high-quality system may produce useless information. This seems to be consistent with D&M's model.

(b) *General Perceptual Measures of the Net Benefits from IS Use* (column 2). As indicated in the discussion of Figure 4, the four remaining classes of variable on the downstream side of D&M's model are really only classifications of measures of *Benefits from IS Use*. A pie can be cut up in many ways, and in Figure 5 the primary cut is based on the distinction between two general-purpose perceptual measures of Net Benefits (that seem likely to be applicable in almost all situations) and all other measures. The two general perceptual measures

(*Perceived Usefulness* and *User Satisfaction*) appear in column 2, and other measures (which include Meaning 1 *IS Use*) are grouped in column 3.

A weakness with the two general measures is that they are both perceptual. Many researchers distrust perceptual measures because people do not necessarily say what they believe, nor do what they say. Worse still, perceptions can be downright wrong. Notwithstanding these difficulties, *Perceived Usefulness* and *User Satisfaction* are potentially useful for many studies because they are conceptually meaningful, and relatively easy to measure. The next few paragraphs define the meanings of these two variables.

(i) In his study, Davis (1989) defined the *Perceived Usefulness* of an application of IT to be "the degree to which a person believes that using a particular system would enhance his or her job performance." However, in the IS Success model in Figure 5, where *Perceived Usefulness* is assessed ex post, the words "would enhance" in Davis's definition need to be replaced by "has enhanced." Thus *Perceived Usefulness* in Figure 5 is "the degree to which a person believes that using a particular system has enhanced his or her job performance or his or her organization's performance."

Perceived Usefulness is not present in D&M's model, but like Meaning 1 *IS Use* in the case of volitional use, it is a potentially good proxy for the benefits of IT use. One advantage of *Perceived Usefulness* over *IS Use* as a proxy for *Net Benefits* is that it retains its meaning even if usage is mandatory. Another advantage is that Davis (1989) has developed a highly reliable instrument for measuring expected future *Perceived Usefulness* that is easily rephrased to past tense.

(ii) With respect to *User Satisfaction*, Naylor et al. (1980) define the general concept "Satisfaction" as "the result of the individual taking outcomes that have been received and evaluating them on a pleasant-unpleasant continuum." Applied to an IS context, *User Satisfaction* is a subjective evaluation of the various outcomes of *IS Use* evaluated on a pleasant-unpleasant continuum. In this case, the relevant outcomes are the *Consequences* depicted in the top-right corner of Figure 5.

The hypothesized relationship between *Perceived Usefulness*, *User Satisfaction*, and the two *Quality* variables in column 1 of Figure 5 is based on the theoretical and

empirical work reported by Seddon and Kiew (1994).¹⁹ Briefly, they argue as follows. First, the existence of factors related to *System Quality* and *Information Quality* in most *User Satisfaction* instruments (e.g., Ives et al.'s (1983) *User Information Satisfaction* measure, and Doll and Torkzadeh's (1988) *End User Computing Satisfaction* measure) is evidence to support the use of these two factors (*System Quality* and *Information Quality*) as independent variables in a variance model of *User Satisfaction*. Second, for very similar reasons, *System Quality* and *Information Quality* should also be influential in determining *Perceived Usefulness*. Third, *User Satisfaction* taps a wider range of needs, costs, and benefits of IT application use than *Perceived Usefulness*,²⁰ so *Perceived Usefulness* may validly be included, along with the other two factors (*System Quality* and *Information Quality*), in a variance model of *User Satisfaction*.

Relationships between the four variables in columns 1 and 2 may thus be represented by two OLS regression models, with *Perceived Usefulness* and *User Satisfaction*, respectively, as dependent variables. These relationships are shown in the path diagram at the left of the IS Success model in Figure 5 (arrows indicate hypothesized causality). In the case of individual users of single organizational information systems, Seddon and Kiew's (1994) and Fraser and Salter's (1995) empirical work (see Figure 2) provides evidence to support these relationships.

How do the variables and relationships just discussed compare to D&M's model (Figure 1a)? The answer is that they are very similar. The two differences are, first, that *Perceived Usefulness* occupies the slot filled by *IS Use* in D&M's model. Here, like Meaning 1 *Use* in D&M's model, it proxies here for *Benefits from Use*. Second, D&M's arrow pointing up from *User Satisfaction* to *IS Use* is modeled in Figure 5 by the feedback arrow from *IS Success* to *Expectations*. This feedback relationship is discussed shortly.

(c) *Other measures of the Net Benefits of IS Use* (column 3). D&M's classification of IS Success measures by

¹⁹ Perceptual instruments for measuring these four variables are included in the appendix to Seddon and Kiew (1994), p. 110.

²⁰ For instance a very cheap old computer may still be *useful* for word processing but many people would not be satisfied with it. So satisfaction must involve the weighing up of a wider range of factors than mere usefulness.

whether they measure benefits to an individual or an organization is helpful and is retained in column 3 of the IS Success model in Figure 5. In addition, a new category, *Net Benefits to Society*, has also been added because there are clearly situations, e.g., of the impacts of widespread use of the Web, where the unit of analysis needs to be our whole society, not just one or more individuals, or one or more organizations.

Meaning 1 *IS Use*, i.e., as a nonperceptual measure of the net benefits of *IS Use*, has been classified as an "Other" measure of net benefits in Figure 5 because it is not as generally useful for measuring IS Success as *Perceived Usefulness* and *User Satisfaction*. Notwithstanding this, in a volitional-use setting, continued *IS Use* (by individuals, organizations, or society) is clearly an important, objective, indicator of net benefits. Even in a mandatory-use setting (e.g., where usage is mandatory for employees or students) *IS Use* is still a valid binary measure of IS Success if it is used to summarize the person in power's overall expectations about the net benefits of continued use of the system by the organization (compared to the net benefits of changing to any alternative system).

Associations or causal relationships between the two general measures of *Net Benefits* in column 2 and the remaining measures in column 3 are hard to specify. As all these column 2 and 3 measures are just proxies for *Net Benefits* it may be that all measures covary, and none causes the other.²¹ However, the approach taken in Figure 5 is that *Net Benefits* is a weighted sum of many positive and negative factors, and that a first-order approximation weighting of each factor can be estimated using an ordinary least squares (OLS) regression model. It follows that if the variables semantically closest in meaning to *Net Benefits* are treated as proxies for *Net Benefits* (the dependent variable), the other IS Suc-

cess variables can be treated as independent variables in the OLS regression model.²²

In Figure 5, the six left-pointing arrows in the IS Success model have been drawn to indicate that *User Satisfaction* and *Perceived Usefulness* are both likely to be semantically closer to the notion of *Net Benefits* than the other measures.²³ Thus the complete IS Success model in Figure 5 shows *User Satisfaction* as being dependent on six variables (*System Quality*, *Information Quality*, *Perceived Usefulness*, *Net Benefits to Individuals*, *Net Benefits to Organizations*, and *Net Benefits to Society*). *Perceived Usefulness* is hypothesized to depend on the same six variables, excluding itself. The approach adopted here is a simple extension of the regression model approach used by Seddon and Kiew (1994). It may not be valid in all situations; it needs to be tested empirically.

The final relationship to describe in Figure 5 is the feedback path from *IS Success* to *Expectations* in the behavioral model. All other things being equal, it is hypothesized that higher *Net Benefits* from past use will lead to higher *Expectations* about net future benefits. Since *User Satisfaction* has been chosen in Figure 5 as the variable closest in meaning to *Net Benefits*, the arrow representing this feedback path in Figure 5 has been drawn from *User Satisfaction* to *Expectations*. However, if a more comprehensive or reliable measure of *Net Benefits* existed in the IS Success model, the feedback arrow would be from that more comprehensive measure to *Expectations*.

That completes the description of the IS Success model in Figure 5. The focus of the respecified model is still very much the same as D&M's. All six categories of IS Success measure that D&M identified in their comprehensive and valuable survey, and two of the three meanings for *IS Use* implicit in their model, are present in the re-specified model. Meaning 1 for *IS Use*, as a proxy for *Benefits from Use*, appears at the bottom of

²¹ This is certainly the approach taken by Doll et al. (1994), who used LISREL to argue that the Doll and Torkzadeh (1988) End-User Computing Satisfaction (EUCS) instrument could best be interpreted as five first-order factors and one second-order factor (EUCS). However, Seddon (1996) has reanalyzed the statistics in the above paper, Doll et al. (1995), and four additional datasets, and concludes that second-order models are not generally appropriate for modeling interrelationships between IS success measures. Figure 5 is consistent with Seddon's (1996) understanding of the situation.

²² By structuring the discussion in terms of OLS regression, one avoids having to say that variable *x* causes variable *y*.

²³ This is, of course, open to empirical refutation. Also, possible causal links down column 3, e.g., from *Net Benefits to Individuals* to *Net Benefits to Organizations*, along the lines of the link between D&M's *Impacts* have not been included because of a desire to avoid the process model connotations of D&M's model.

column 3 of the IS Success model as an example "Other" measure of net benefit. Meaning 2 for *IS Use*, the behavior, appears in the box labeled *IS Use* in the IS Use model. However, because of the need to maintain clear definitions for all variables, Meaning 3 for *IS Use* (the process-model meaning) has been omitted deliberately from Figure 5.

5. Comments on the Overall Respecified Model

Taken as a whole, three advantages of the respecified model over D&M's model are as follows:

1. In the respecified model, *Use* of the system is perceived to have *Consequences* of various kinds. These are observed, experienced by, or reported to the individual evaluator, who forms his or her opinions about aspects of the success of the information system. It is ultimately these value judgments about the contribution of the system to the "well-offness" of some stakeholder(s) that the researcher tries to make or measure.

Researchers who use the above simple approach as the basis for choosing success measures and exploring relationships between them will be less likely to waste time exploring false trails than if they used D&M's (1992) model. For example:

(a) One should not assume that greater *IS Use* per se is a good thing (although greater *Perceived Usefulness* and *User Satisfaction* probably are).

(b) One should be aware that in the relationship from *System Quality*, *Information Quality*, and *User Satisfaction* to *IS Use*, and from *IS Use* to *Individual Impacts*, *IS Use* does not play the role of a success measure.

(c) One should not waste time exploring causal path relationships from *User Satisfaction* to *Individual Impacts*. If *IS Use* and *User Satisfaction* are viewed as proxies for *Net Benefits* there is no reason why variance in either of them should have any causal influence on variance in D&M's other two net benefits *Impacts* measures in Figures 1a and 4. In fact, as shown in Figure 5, the direction of influence is probably the reverse.

2. *Perceived Usefulness* is included in the re-specified model as an IS Success measure. The work of Davis (1989, 1993), Davis et al. (1989), and others has shown repeatedly that *Perceived Usefulness* is an important predictor of future *IS Use*. If people use IT because they

expect it will be useful, it would seem eminently sensible to measure success by whether they found it was actually useful. It is therefore argued that the IS Success model is strengthened by including *Perceived Usefulness* explicitly as a key IS Success measure in Figure 5.²⁴

3. In the respecified model, the feedback loop from *Perceptions* back to *Expectations* explicitly recognizes the importance of learning. The model in Figure 5 asserts that *Expectations* are continuously being revised in the light of new experiences with the system. In a clockwise fashion, revised expectations lead to revised levels of *IS Use*, which in turn lead to revised perceptions of IS Success, and ultimately, to revised expectations. It is important that the possibility of these learning effects is incorporated explicitly into a model that predicts *IS Use*. (At present, for instance, it is not incorporated explicitly into Davis et al.'s 1989 TAM.) Although D&M did not set out to build a model that predicts *IS Use*, it seems likely that the arrows in Figure 1a from *Use* down to *User Satisfaction*, and from *User Satisfaction* up to *Use*, were intended to recognize the possibility of this sort of learning effect.

6. Conclusion

D&M's (1992) comprehensive review of the empirical literature represents an important step towards consolidating our knowledge of IS Success measures. However, in the limited space available at the end of their paper (where their Figure 2 appears, Figure 1a in this paper), it was not possible to provide detailed theoretical support for the interrelationships suggested in their model. Now, having worked with the model for some years, and having tested part of it empirically, it has become apparent that the inclusion of both variance and process interpretations in their model leads to so many potentially confusing meanings that the value of the model is diminished. By clarifying the meaning of *IS Use*, introducing four new variables (*Expectations*, *Consequences*, *Perceived Usefulness*, and *Net Benefits to Society*), and reassembling the links between the variables, it has been possible to develop the re-specified and slightly extended model of *IS Use* & *IS Success* shown in Figure 5.

²⁴ *Perceived Usefulness* was the IS Success measure chosen by Franz and Robey (1986).

Users of the respecified model must be aware that judgments about IS success are sometimes highly political, and that people's careers may be at stake. Different stakeholders (having different needs and interests) will probably attend to different cues, attribute different outcomes to the system, ignore outcomes they don't want to think about, and evaluate the "same" outcomes differently. When senior management are asked to evaluate their systems, they will tend to talk in terms of the system's perceived contribution to organizational profitability or to the efficiency of the organization. By contrast, clerks in an organization are more likely to be concerned with whether the system makes it easy or difficult for them to record new data, correct errors, or extract the detailed information they require. Both views are valid. Thus researchers need to think carefully about who is to be asked to do the evaluation, and what those peoples' interests are in the outcomes of the evaluation process. Subjects and measures should then be chosen accordingly.

Within this context, it is hoped that the respecified model provides a clearer, more theoretically sound conceptualization of relationships between the various IS Success constructs identified by D&M, and so will assist with D&M's goal of helping future researchers choose an appropriate mix of IS success measures.²⁵

²⁵ In the course of many revisions, this paper has benefited from comments from many people. Thanks to Barry Spicer, Peter Weill, Izak Benbasat, Stephen Fraser, Liz Roberts, Sandy Staples, the anonymous reviewers at ISR, colleagues at the Departments of Accounting and Finance and Information Systems at The University of Melbourne, Curtin University, the University of British Columbia, ACIS 95, and last but not least, Bill DeLone and Eph McLean for their encouraging words during their commentary on an earlier paper at ICIS 94.

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