Developing Software in a Bicultural Context: The Role of a SoDIS® Inspection

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ABSTRACT

This article introduces the SoDIS process to identify ethical and social risks from software development in the context of designing software for the New Zealand Maori culture. In reviewing the SoDIS analysis for this project, the tensions between two cultures are explored with emphasis on the (in)compatibility between a Maori worldview and the values embedded in the SoDIS process. The article concludes with some reflections upon the key principles informing the professional development of software and ways in which cultural values are embedded in supposedly neutral technologies, and reviews the lessons learned about avoiding colonization while working on a bicultural project.

Keywords: colonization; culture; indigenous peoples; Maori; risk assessment; software; software development impact statements; software ethics; software inspection

INTRODUCTION

Rogerson and Gotterbarn (1998) developed an early warning system that can be used by software developers to identify and address potential ethical, professional, and social risks in software development. The method, a software development impact statement (SoDIS) inspection (Gotterbarn, Clear, & Kwan, 2004), uses ethical relations to connect broad-based project stakeholders to the project tasks and deliverables. The SoDIS methodology based upon standard Western ethical values has been proven effective in a variety of environments. It has been applied to the development of a data warehousing project in Boston, the development of software for the analysis of psychometric test data for youth, Web sites in New Zealand, and electronic voting in the UK. In each of these cases, the SoDIS inspection process identified significant risks in the develop-
ment process and in the final product (Gotterbarn & Rogerson, 2005). This identification of the risks gave management the opportunity to develop successful risk mitigation strategies.

This article introduces the Software Development Impact Statement process and discusses its application to a bicultural project. In reviewing the SoDIS analysis for this project, the tensions between the two cultures are explored with emphasis on the compatibility between a Maori worldview and the values embedded in the SoDIS process. The article concludes with some reflections upon the key principles informing the professional development of software and reviews the lessons learned about working on a bicultural project.

The article recounts the application of the SoDIS process to an ethically sensitive project involving software development for a Maori Tribal Authority. Maori are the indigenous people of New Zealand, a bicultural society in which the other culture could broadly be termed Western (comprising subsequent New Zealand settlers from a predominantly European immigrant community). Clear and Gotterbarn used this opportunity to address action research questions such as the following:

1. Would the ethical connectives between task and stakeholder that had been derived from software codes of ethics and codes of practice be adequate to identify ethical risks in a manner that was sensitive to the indigenous culture in this bicultural context?
2. Would the use of the SoDIS process colonize the software system for Maori stakeholders with Western cultural values?

BACKGROUND AND TERMS RELATED TO THE PROJECT

Historical Context

The history of New Zealand, as with most former colonies, reflects a complex series of struggles between the colonizing settlers and the indigenous peoples. A unique feature of New Zealand history is the signing of the Treaty of Waitangi in 1840 between the British Crown and a large number of the indigenous Maori tribes. This controversial treaty, in which the Maori people engaged as equal parties in a partnership whereby they ceded a degree of sovereignty to the crown in exchange for certain rights, since has been regarded as “the legitimate source of constitutional government in New Zealand” (Walker, 1990, p. 98). The English and Maori language versions of the treaty differ in substantial ways and are each open to quite different interpretations. Subsequent debate has revolved around these differing interpretations of the treaty, and consequent actions have been taken by the Crown and its agents. Walker (1990, p. 98) observes that “acquisition, control and, ultimately, expropriation of land were the key factors in the consolidation of sovereignty” by the Crown. This was in spite of the treaty’s guarantees to the Maori signatories of “full exclusive and undisturbed possession of their Lands and Estates, Forests, Fisheries, and other properties which they may collectively or individually possess, so long as it is their wish and desire to retain the same in their possession” (Walker, 1990, p. 92). He argues that the “outcome of colonization by the end of the century was impoverishment of the Maori, marginalisation of leaders and chiefly authority and a structural relationship of Pakeha [European] dominance and Maori subjection” (Walker, 1990, p. 10).

Relatively recently, a process of reconciliation has been engaged in by the Crown, one element of which has involved the devolution of responsibilities from the former Government Department of Maori Affairs to Maori tribal authorities known as Runanga. The intention was to move from a paternalistic governmental model of service provision to Maori toward a self-determined model managed by the Maoris themselves. An earlier key step in the reconciliation process had been the establishment in 1975 of a specialized tribunal (the Waitangi Tribunal) to hear and to adjudicate upon Crown breaches of the treaty brought by Maori claimants. A number of settlements have resulted from this process, in which significant financial
compensations have been made to claimant tribes.

One of the most significant nationwide settlements resulting from the Maori Fisheries Act 1989 and the subsequent Deed of Settlement 1992 has resulted in the establishment of the Maori Fisheries Commission, a Crown body with more than NZD$700 million worth of fisheries assets to be redistributed to several claimant tribes. This redistribution will be effected by the establishment of a “new trust, Te Ohu Kai Moana … with iwi (the Maori tribes) as beneficiaries” (Maori Fisheries Bill, 2003, p. 1). The trust will undertake a process of allocation of groups of shares to tribal authorities, who then will apportion them accordingly to bona fide members of that tribe. “For individual Maori to become shareholders in this asset they must be registered with their iwi” (Tuhono, 2004).

Thus, in order to demonstrate membership of a tribe, a process of tribal registration similar to voter registration will be required.

**Project Context**

In mid-2002, a number of students at Auckland University of Technology (AUT) began work on a project to extend the existing IT systems of a Maori tribal authority, Te Runanga a Iwi o Ngapuhi (TRAION), the statutory body representing the Ngapuhi tribe, or iwi (Clear et al., 2004). Proposed changes in a broadly conceived project included the following:

- Online registration of tribal members
- Linking members to several groupings of significance to Maori
  - Extended family (*whanau*)
  - Subtribe (*hapu*)
  - *Marae* (a meeting-house complex used for several cultural purposes and serving the Maori community centered in that location)
- Creating a database of genealogical (*whakapapa*) information
- Creating a database of interests in communally owned tribal land

The TRAION project, then, was entering into sensitive areas. For Maori, “Identity and worth were found in family and tribal connectedness [and] …identity was linked to both ancestry and place” (King, 2003, p. 77). As a consequence, Maori people have known sensitivities about research related to *whakapapa* (genealogical and land-based information), which is considered a *taonga* (treasured possession) particular to the groupings (*whanau*, *hapu*, and *iwi*) who have interests in this information.

To better articulate the risks and to investigate the issues inherent in computerizing such sensitive information, a Software Development Impact Statement (SoDIS) analysis was undertaken.

**THE SODIS PROCESS**

There is significant evidence that many software projects fail because, during development, they do not adequately identify and address significant qualitative risks, including social, professional, and ethical risks. Rogerson and Gotterbarn (1998) developed a process, Software Development Impact Statements (SoDIS), to address this problem. The SoDIS process was prototyped in software (SDRF, 2005). These unidentified risks and associated software failures can range from trivial annoyances to cumbersome and dangerous situations. Developers frequently are surprised by the impacts of the software they develop and their own failure to pay attention to a wide range of risks. Sometimes, the missed risks can have tragic consequences.

A major cause of failed software projects is the narrow focus of risk analysis on only the concerns of the developer and the customer. Risk analysis sometimes is extended also to include those with a financial stake in the software. But this limited scope of analysis excludes those who do not have a financial stake in the development of the software. Because they
have no financial stake in the development of the software, the needs of the pacemaker recipient, or the vehicle passenger whose life is affected by the successful application of anti-lock braking software, often are overlooked. The SoDIS methodology is designed to include in the risk analysis those people who are impacted by the development of the software. Broadening the base of stakeholders requires a broadening of the types of risks considered.

The decision support technique, Software Development Impact Statements, is a modification of an environmental impact statement. Software impact statements, like environmental impact statements, are used to identify potential negative impacts of the planned software and to specify actions to mediate those impacts. SoDIS is intended to reflect both the software development process and the more general ethical obligations to various stakeholders. In particular, it was designed to access the possibility of ethical, professional, and social risks — risks that occur where the software interacts with people or modifies their social environments.

The SoDIS process is an ethical decision support process insofar as it focuses on the developer’s responsibility to consider the diversity of stakeholders and the special nature of the project tasks. The SoDIS analysis precedes the software development. A SoDIS analysis identifies concerns about the potential impact of particular planned tasks on individual stakeholders. It highlights changes in some planned tasks and additional possible tasks that are needed to prevent any anticipated problems. The analysis is done first during the planning stage for software development.

On a very high level, the SoDIS process can be characterized as examining the way every task or function of a proposed system impacts a stakeholder. Unacceptable potential impacts are identified, and the developer has the opportunity to address the risk before the product is developed. The process generates a series of questions of the form, “Might task n have a specified ethical impact on the particular stakeholder?” For example, a retirement payment system may require all data on a single screen. “Failing to take into consideration the needs of” is an ethical impact issue. Thus, a SoDIS question might be, “Might putting all data on a single screen fail to take into consideration the needs of the senior citizen (visually impaired) stakeholder?”

The SoDIS process can be reduced to four stages: (1) the identification of the immediate and extended stakeholders in a project; (2) the analysis of the tasks in a project; (3) for every task for each stakeholder, the identification of potential ethical issues raised by the completion of that task; and (4) the recording of the details and solutions of those ethical issues and a decision whether the current task needs to be modified or a new task created in order to address the identified concern. The process of developing a SoDIS encourages the developer to think of people, groups, or organizations related to the project (stakeholders in the project) and how they are related to each of the individual tasks that collectively constitute the project. This encouragement is done by generating a series of questions for the analyst.

The generation of these questions requires the list of tasks, the potential issues connecting (ethical relata and impact issues) task and stakeholder, and the list of stakeholders. The task list can be at a variety of levels of abstraction and is provided by the requirements, function lists, or a project task list.

The SoDIS process identifies overlooked risks through the inclusion in the analysis of a broader range of stakeholders. Stakeholders include individuals or groups who may be directly or indirectly affected by the project and thus have a stake in the development activities.

**Stakeholder Identification Techniques**

The stakeholders can be identified in several ways. A preliminary identification of software project stakeholders is accomplished by examining the system plan and goals to see
who is affected and how they may be affected. When determining stakeholders, an analyst should ask whose behavior, daily routine, or work process will be affected by the development and delivery of this project; whose circumstances, job, livelihood, or community will be affected by the development and delivery of this project; and whose experiences will be affected by the development and delivery of this product. All those pointed to by these questions are stakeholders in the project.

The identification of stakeholders also must strike a balance between a large list of stakeholders who are ethically remote from the project and a list of stakeholders that only includes a small portion of the ethically relevant stakeholders. Rogerson and Gotterbarn (1998) proposed a method to help achieve a balance between an underestimation and overestimation of the relevant stakeholders based on Gert’s (1988) moral rules. Gert gives the 10 basic moral rules shown in Table 1. These rules carry with them a corresponding set of rights, such as the rights to liberty, physical security, personal liberty, free speech, and property.

One approach to stakeholder identification is to use Gert’s (1988) rules as stakeholder search criteria, search for stakeholders who would be caused pain by a particular project task, search for stakeholders who would be disabled by a particular project task, and so forth. A preliminary identification of software project stakeholders is accomplished by listing each of these rules and rights and examining the system plan and goals to see who is affected and how they may be affected. For example, according to the rule “don’t cause pain,” we should ask if the system changes the level of pain felt by anyone.

Stakeholders are also those to whom the developer owes an obligation. The imperatives of the Software Engineering Code of Ethics and Professional Practice and similar codes of ethics and practice define the rights of the developer and other stakeholders. These imperatives can be used to guide the stakeholder search.
The process of identifying stakeholders also identifies their rights and the developers’ obligations to the stakeholders.

**Ethical Relata**

These codes also can be used to identify the impact issues connecting tasks and stakeholders. Many of the computing codes have similar imperatives, which embody the software profession’s views of responsibility. The SoDIS process uses abstracted imperatives from many codes and organizes them under general moral principles. These imperatives have been organized as a set of 32 impact issues, which form questions when relating tasks and stakeholder. There may be some special circumstances that are not covered by these 32 questions, so the SoDIS analyst can add impact issues. Only codes of western professional computing societies were abstracted (e.g., the British Computer Society, the Association of Computing Machinery, etc.). There is in each of the codes a clear statement that protects individual rights of ownership. The ethical umbrella under which the SoDIS was developed seems to reflect a Western, largely individualistic worldview (see Hofstede [1980] and discussion in the section “The Ethical Problem”) of software development and ethical rights and responsibilities.

We now can modify our initial research questions as follows:

1. Would the ethical connectives between task and stakeholder that had been derived from software codes of ethics and codes of practice be adequate to identify ethical risks in a manner that was sensitive to the indigenous culture in this bicultural context? This can be put as the following more general question:

   1*. Does the application of a Western worldview of software development constrain (impact, affect, colonize) the system it develops with more general ethical values (which would include indigenous values or the general value sets implicit in the Western worldview)?

2. Would the use of the SoDIS process colonize the Maori software system with Western cultural values? This is now divided into the following two questions:

   2*. Does the SoDIS process really embody Western values, or does it embody a view that is conditioned by software development rather than a social-ethical culture?

   2**. Does the SoDIS process necessarily force such constraints on a different culture?

   Question 2** is different from the question, “Can the process be used in such a way to colonize values into another culture?” A simple example of software colonization is the loss of accountability in vote counting caused by the development of vote counting machines that do not produce paper audit trails for votes cast.

**THE PROPOSED PROJECT AS TARGET FOR THE SODIS PROCESS**

The Ngapuhi iwi, 103,000 according to the 2001 census, have their interests represented and managed by Te Runanga a Iwi o Ngapuhi, the project client. Because the majority of these members live outside the tribal boundaries in the Northland, identifying and

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**Table 1. Gert’s moral rules**

<table>
<thead>
<tr>
<th>Don’t kill</th>
<th>Don’t cause pain</th>
<th>Don’t disable</th>
<th>Don’t deceive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don’t deprive of freedom</td>
<td>Don’t cheat</td>
<td>Don’t deprive of pleasure</td>
<td>Keep your promises</td>
</tr>
<tr>
<td>Do your duty</td>
<td>Obey the law</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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maintaining contact with members is a costly and difficult exercise.

The software project, TRAION, was to replace the current paper-based membership system with only 2,000 recorded members. The *iwi* is very large and dispersed, but a complete roster is needed for representative decision making in *iwi* matters, such as the long-term management and reporting of tribal resources and the facilitation of Treaty of Waitangi settlements. Communicating with the diverse membership is facilitated by a Runanga-developed Web site (http://www.ngapuhi.iwi.nz). A major function of the Web site is the distribution of *iwi* membership application forms. “Nevertheless, providing a fully dynamic, robustly architected website had been beyond the resources of the Runanga at the time of commissioning the project” (Clear et al., 2004, p. 8).

**The Tribal Membership System**

One of the immediate needs of the Runanga was the establishment of an up-to-date membership system verifying that people, indeed, are members of the *iwi*. This list was required for *iwi* management and the potential disbursement of settlement funds, a task made more difficult by the international dispersal of members of the *iwi*.

**Implications for the Project: Technical and Social Issues**

To meet the membership recording needs of the Runanga, it was decided that the system would be Web-based. The project as originally conceived (i.e., developing a full genealogical/land-based system) could not be completed in the time allocated for a student project. “Developing a land information system revolves around not merely providing the right technology, but the difficulty of the information gathering process and the accuracy and currency of the results garnered from the process” (Clear et al., 2004, p. 10).

Determining land ownership is very complex for Maori. As in other societies, land is inherited through family linkages, but there is not a complete paper trail of all of these linkages. The most accurate information can be found by investigating the family relationships and background of land ownership candidates. Another problem is that the Maori culture is community-based, so there are often hundreds of owners for one block of Maori land, with each owning a proportion. The records for these dispersed owners are often inaccurate.

The three factors of land, genealogy, and tribal membership are interconnected and provided the original scope of the investigation. A decision was made to focus on the membership system requirements, with the database designed to allow for future implementation of genealogical and land information system requirements.

**Membership Information Structure Difficulties**

Given the lack of genealogical documentation, tribal debate informs matters of *whakapapa*, and every piece of information is important in genealogical research, regardless of the correctness of the information at the time of examination. Even dubious data must be preserved to allow for later reinvestigation. Not only must inconsistent stories be maintained, but the system also must track the time-based nature of genealogical data. Instead of a simple hierarchical structure, the Maori also have an overlapping network structure in different groups (i.e., family, *hapu*, tribe, etc.). The levels of family relationship (shown in Figure 2) include parent-child, *whanau* (extended families), *marae* clusters within *hapu* (local meeting complexes within the territories of a subtribe), and *hapu* clusters within a larger tribe (*iwi*). The *Whanau* is not a simple genetically related group but frequently includes members who have been adopted formally from other *Whanau*; it also includes those who have been adopted casually by a *Whanau*. Thus, someone who is adopted casually into a particular family will be a member of that family’s *marae* of their *hapu* in their *iwi*, but that same person is related genetically to a different family that could belong to a completely different *iwi*.
THE SODIS APPLIED TO THIS PROJECT

Smith (1997) identified several Maori concerns about putting cultural information on the Internet, including concerns relating to threats to cultural values, loss of control of information, intellectual and cultural property ownership issues, accuracy and authority of information, the commercialization of information, and access issues. Based on consultation with the Maori about computerization of Land Court records, the Department of Courts (1999, p. 3) noted that Maori had objected to the database being made available over the Internet and believed “that management of the records (paper and electronic), the information therein, and access, has to be consistent with the following principles: the mana (authority) of the records/information comes from iwi, [and] whakapapa is intrinsically tapu (sacred).”

The Maori say that cultural information (here, whakapapa) has an intrinsic value, while in the West, information is viewed primarily in an instrumental sense; the value of the information is a function of its usefulness. In addition to the cultural concerns, there are significant technical issues with the TRAION project.

The Ethical Problem

Given that whakapapa is sacred, would the analysis of the project tasks manage to identify the development of this database as a potential instance of cultural colonization of the Maori by another culture?

Our investigation requires at least a distinction between the two cultures. Culture is a complex phenomenon and generalizations are all too easy to make. Nonetheless, differences do exist, and some categorization such as the dimensions proposed by Hofstede (1980) can be helpful. In one such example, at a country level, New Zealand has been categorized, along with countries such as Canada, Great Britain,

Figure 2. Iwi relationship structures (adapted from Clear et al., 2004)
and the United States, as possessing an individualistic culture (Jarvenpaa & Leidner, 1998), whereas Maori would be classified more appropriately as possessing a collectivist culture. The group is a dominant structure in the Maori world, just as the individual is dominant in the Western perspective of the previous country grouping. Avison and Myers (1995, p. 52), arguing that culture is essentially an emergent phenomenon, have refuted simplistic definitions, noting, “The assumption that cultures are separate, distinct entities which identify and distinguish one group from another … is too simplistic.” As with all generalizations, there are obvious exceptions with each culture, but the individualism — collectivism dimensions — seem to be based upon strong conceptual foundations. Given this obvious difference in perspective, forcing the values from one culture onto another would be an example of ethical/social colonization.

Therefore, when engaging with Maori as with many other indigenous cultures, we need to acknowledge that the Western perspective is different from the Maori. To develop software that accommodates this difference in perspective requires that we work in a partnership model and that we have tools and techniques that can surface issues based on these different perceptions. The SoDIS process is one such analytical technique. The SoDIS was designed with a fiduciary model of professionalism in mind (Bayles, 1981). A fiduciary model of professionalism imposes high standards of development, but the resulting software is developed in partnership with those affected by the developed product. But we are wrestling with the extent to which its underpinning logic is essentially Western and fails also to address the different value systems of indigenous peoples who come from a strong tribal or clan-based community culture. The tools used require a focus on what that community values.

THE RESULTS OF THE FIRST APPLICATION

The SoDIS process is part of an inspection process. The first step in the SoDIS inspection process (Gotterbarn, Clear, & Kwan, 2004) is the identification of potential high-level risks — clusters of concern. The awareness of these high-level issues is used as a filter for the SoDIS analysis. In application of the SoDIS process through a SoDIS inspection of the TRAION project, the following four distinct clusters of concern were identified:

- Client-developer communications
- Sensitive data
- User experience
- Academic considerations

Within these clusters, the specific concerns later identified during the detailed SoDIS analysis related to several further subcategories.

Client-developer communication concerns that were identified related to a conflict of interest between the local proxy client, who was a member of the iwi and also of the academic staff at the developers site, and the remote client at the Runanga itself, who would operate the final systems once delivered. Questions arose about the ability of the proxy client to adequately represent the requirements to the developers and mechanisms for securely transferring sensitive project related documentation between the development and client sites.

Sensitive data concerns related to reasons for collecting data (consistency with privacy legislation and mechanisms for obtaining consent for provision of data for genealogical research purposes [http://www.caldeson.com/RIMOS/nzguide.html]) and access to data (determining authorization protocols, managing privacy considerations, keeping data over time, managing multiple copies of the database, etc.). Cultural sensitivity and avoiding exploitation through commercialization were concerns, especially over display of cultural artefacts over the Web or use of whakapapa information for commercial purposes.
The user experience concerns related to unusual circumstances (e.g., where contested values over tribal groupings were held and where members could be refused enrollment under their chosen groupings, or when dealing with cases of adoption and the desire to represent both natural and adoptive lineages); refusing membership and the resulting impact on tribal members, whether that refusal was by design or through administrative, security, or data integrity occasioned errors; access and performance issues for rural members with slow dial-up connections; visual and language impairments (e.g., the impact of Maori language text without translation for young members who are more frequently non-Maori speakers and for the elderly who have poorer eyesight and for whom the choice of a suitable font will be an important consideration).

Academic considerations were concerns related to developer inexperience with taking a system through all the activities of a full development life cycle to production use, and time constraints potentially leading to shortcuts and quality compromises.

This SoDIS-generated list of Clusters of Concern and subcategories did not impose Western social values. The list appears as a relatively culturally neutral collection that has identified issues that would be of concern to any professional developer and likewise to their clients and other stakeholders in the system. As we shall see, there are, however, some issues here that are of specific concern to Maori due to their cultural priorities and values. We return to the research question 1* — Is the SoDIS with its Western cultural base capable of including indigenous values?

SOME SEEMINGLY CULTURAL DIFFERENCES RELATED TO THE DATABASE AND THREATS TO CULTURAL VALUES

In this clash of values between Maori and Western perspectives, however, we have identified some critical issues. Broadly speaking, we can say that Western culture is inherently individualistic (whether through natural persons or notion of the firm as a natural person) and tends to assert property rights through ownership; it also tends to view resources through a utilitarian ethic as opportunities for personal gain through some form of exploitation. Maori culture, by contrast, is group-based, emphasizing the collective good and views resources not simply as opportunities for exploitation but from an innate sense of oneness with the natural world, as entities deserving respect in their own right. The notion of collective responsibility for the guardianship of these natural resources is an accompanying strong cultural imperative.

Solomon (2000, p. 4) phrases the distinction as follows:

Acknowledging the spiritual dimension of their universe and respecting the mauri or central life force of every living thing was fundamentally important to the Maori world view. In other words, the reciprocity of obligations was balanced against the right to use and exploit. This can be contrasted with the notion of intellectual property rights which focuses on the economic right to exploit for profit and financial gain. The needs of the individual, and corporate legal personalities such as multinationals, are preferred to the collective good.

Under this capitalist model, resources are viewed entirely as a means of exploitation for economic gain. There is little or no reciprocity or respect for the integrity of the resources as living and breathing entities with their own mauri or life force.

A New Stakeholder

This raised an interesting question. We hold a model of data as information to be used for our purposes, which underpins the informational perspective of whakapapa. Does our model violate the Maori ethic relating to whakapapa as a sacred entity warranting respect and for
whose respectful guardianship we have a collective responsibility? Thus, the notion of a data collection itself (here, the whakapapa is the collection considered) having an inherent integrity in its own right leads us to reconsider the notion of stakeholder. Not only the impacted individuals and groups but even the very information may be a stakeholder, if we adopt a Maori perspective (Floridi, 1998). Thus, including whakapapa in our stakeholder list and conducting subsequent analysis to determine whether the integrity of the whole collection is at risk by actions in the course of the project may assist in bridging the gulf between the two cultures. In this way, we may apply a tool based on Western value systems in a manner nonetheless consistent with the worldview of a very different culture. The key is being able to adopt the Maori perspective when doing the analysis.

The inspection itself had identified as a concern issues to do with data integrity, in general, but had not done so through a perspective that animated in this way the data itself as a collective stakeholder. Thus, the Maori perspective appears capable of being represented through the SoDIS inspection process, but only if the analysts themselves adopt a similar and compatible (in this case, animist) mindset. This is a subtle but significant shift in thinking. Research question 1* is answered affirmatively. The SoDIS process is capable of identifying more general value issues.

2** is not resolved.

ANOTHER SENSE OF COLONIZATION AND THE SODIS WESTERN PRINCIPLES

Myers and Young (1997) have noted how an information system may act as a steering mechanism enlisted to serve the agenda of a power elite, and, in this way, the system itself may act as a colonizing device. While the term information system has been used by Myers and Young (1997), it equally might be substituted by a systematic process, a set of processes, or a software tool used in support of a process. One reason for the concern about cultural ethical colonization is the fact that the ethical relata in the SoDIS process were derived from a Western cultural-ethical perspective embodied in codes of professional ethics. A necessary condition in order for the process to avoid colonization is its application from a Maori perspective. But is that a sufficient condition, or does the SoDIS process’ seeming foundation in a Western ethic mean that the use of the process in other cultures necessarily colonizes social and ethical values in this way?

Our initial questions were (1) Would the ethical connectives between task and stakeholder that had been derived from software codes of ethics and codes of practice be adequate to identify ethical risks in a manner that was sensitive to the indigenous culture in this bicultural context? and (2) Would the use of the SoDIS process colonize the Maori software application with Western cultural values?

Did the SoDIS Have These Threats — 1* Was it Adequate to the Task? and 2** Did it Necessarily Act to Colonize the Maori Culture?

a. SoDIS and Western Culture or Professionalism. The SoDIS process embodies standards of professionalism, which, at a certain level, are universal but may be sociologically defined as merely a set of norms. However, there does appear to be a common ethic inherent in the international community of practice (Wenger, 1998) constituted by professional software developers. Is this ethic to do their job well, sensitively, and in a manner that does not cause harm, a universal ethic of the profession?

b. The derivation of the connecting issues between tasks and stakeholders in the SoDIS analysis was driven by ethical imperatives common to software codes of conduct and codes ethics. A significant number of ethical imperatives were gathered from the various codes and were assigned as instances to one or another of Gert’s (1988) moral rules. Some of the
imperatives derived from professional codes did not fit clearly under any particular Gertian moral rule. These imperatives were related specifically to a moral approach to a project and did not have a stakeholder other than the project itself. These included issues like “require the developer to work on projects with infeasible goals.” This process identified 32 common issues distributed among five distinct principles depicted in Table 2.

As some imperatives seemed to belong equally under two different Gertian rules, it was decided to collapse the rules under more general moral principles, so “Don’t kill” and “Don’t cause pain” were subsumed under the principle “Cause harm.” The negative form of the principles was used so that when a question was answered with a yes, it would indicate an ethics violation. For example, affirming that “a particular task will cause harm to a stakeholder” indicates the need for remedial ethical action.

The resulting generic SoDIS principles and the relation to Gert’s rules are in Table 2.

Some of the rights and obligations identified when following this method of categorization may be in conflict, and it will become necessary to prioritize how these rights are addressed and which of them can, within the bounds of the five previous principles, be addressed. This prioritization, of course, involves value decisions and a setting of priorities among values identified. As Rikys (1980, p. 26) has noted, these value-determined priority choices may create an opportunity for cultural exclusion, since “if planners are not exposed to or in possession of some values, these values will fail to be reflected in the planning policies and priorities which result from planning.” One of the general ways to help prioritize the ethical obligations within a project is to determine what actions are necessary in order to satisfy the perceived obligation and to evaluate those actions in terms of whether they are morally required, morally wrong, or merely morally permissible. This approach to evaluating potential actions is a variation on Green’s (1994) decision tree for assessing obligations.

### Colonization of Social and Ethical Values

One of the research questions in general and in particular for a multicultural process is related to the derivation of the ethical issues relating the task and the stakeholder. This potential problem may be more likely because change of the moral rules used in the SoDIS may have an impact on the way stakeholders will be identified. It may seem that this change might be a cause of ethical colonization.

#### Justification of the Process as Non-Colonizing

There are three items that weigh against the charge that the SoDIS engages in ethical colonization. The first is that the underlying premise of the SoDIS is an analysis of an expanded set of stakeholders. The second is that the set of principles and questions is expandable by the user and, thus, does not mandate the ethics of the analyst. Third, the ethical questions are answered from the analyst perspective and subject to the analyst’s interpre-

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### Table 2. Alignment of SoDIS principles with those of Gert

<table>
<thead>
<tr>
<th>SoDIS Principles</th>
<th>Gert’s Original 10 Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project issues (no stakeholder focus)</td>
<td>none</td>
</tr>
<tr>
<td>Cause harm</td>
<td>Don’t kill; don’t cause pain</td>
</tr>
<tr>
<td>Unreasonably restrict</td>
<td>Don’t disable; don’t deprive of freedom</td>
</tr>
<tr>
<td>Involve deception</td>
<td>Don’t deceive; don’t cheat</td>
</tr>
<tr>
<td>Conflict with your responsibility toward</td>
<td>Don’t deprive of pleasure; keep your promises; do your duty; obey the law</td>
</tr>
</tbody>
</table>
tation. In this regard, it may be the analyst who is guilty of ethical colonization rather than the SoDIS process. This risk normally is mitigated by conducting the analysis process jointly with stakeholders from the client organization or community. This ensures that participants are well-versed in the cultural context and subject domain.

**No Ethical Colonization**

First, the process expands rather than narrows who the stakeholders are so that it broadens the issues and is not colonizing. If the stakeholder expansion were consistent with the Western business ethics model that the primary stakeholders in any project are only those who have a financial interest (Mitchell et al., 1997), then enlarging the stakeholder base indeed would be colonizing. As we have seen, however, stakeholders are identified by the following three questions that address affected parties in their cultural circumstance:

- Whose behavior, daily routine, or work process will be affected by the development and delivery of this project?
- Whose circumstances, job, livelihood, or community will be affected by the development and delivery of this project?
- Whose experiences will be affected by the development and delivery of this product?

By stakeholder, we mean individuals or groups who may be affected directly or indirectly by the project and, thus, have a stake in the development activities. Those stakeholders who are affected negatively are particularly important regarding ethical sensitivity, because they are often the ones overlooked.

Negative effects include both overt harm and the denial or reduction of goods. So, obviously, the development of a medical software package that delivered erroneous dosages of medicine that killed patients would have a negative effect. But SoDIS analysts also would include software that limited people’s freedom of expression as having a negative effect. Limitations on positive ethical values and rights are negative effects. It can also be argued that the failure to promote positive ethical values is also a negative effect. This is the model that was used in part for the project questions about tasks.

Therefore, we extend the traditional software project stakeholder list from customers and corporations or shareholders to include all those who will be affected by the software and by its production. This includes users of the software, families of the users, social institutions that may be altered radically by the introduction of the software, the natural environment, social communities, software professionals, employees of the development organization, and the development organization itself. If the analysis is done from a Maori perspective, those affected further include *whakapapa* and related social groupings.

Space precludes a fuller discussion here, but this inclusive motivation could be considered to be broadly consistent with the Habermasian (1984) desire to avoid distorted forms of communication, whereby dominant groups use systems as mechanisms to effect a “colonization of the lifeworld” (Myers & Young, 1997, p. 226) of other groups.

Second, the SoDIS is tailorable in two ways: (1) new questions can be asked and existing ones can be ignored and (2) the meaning of terms is conditioned by one’s worldview. A basic assumption of the SoDIS process is that the original ethical relata are a starting point for the analysis. The SoDIS analyst should add appropriate ethical relata to the analysis. The ethical relata are about software development impacts.

Third, the questions are answered from the perspective and understanding of the analyst. The analysts answer questions from the perspective of the stakeholder. The effect of taking the stakeholder perspective can be seen by looking at some specific ethical issues and the guidance contained in the SoDIS process. For example, the principle, “Does task cause harm to the stakeholder?” includes the alteration of information (interpreted from a Maori
perspective to include whakapapa) as a potential harm. This approach also facilitates the addition of context-relevant stakeholders. So, in the case of the Ngapuhi, the information is a stakeholder who is exposed to significant risks.

Under the principle cause harm are the ethical relata that follow.

Does the task in question:

- Allow unauthorized access or alteration of the data of the stakeholder?
- Violate the privacy and confidentiality of the stakeholder?
- Discriminate against the stakeholder?
- Fail to take into consideration the needs of the stakeholder?
- Involve the design or approval of software that may lower the quality of life of the stakeholder?
- Cause loss of information, loss of property, property damage, or environmental impacts that affect the stakeholder?

It is clear from the earlier discussion that these principles are broad enough when interpreted from a Maori cultural perspective to encompass most of their specific concerns with this project.

Even if the SoDIS process were to attempt to colonize, we have seen Maori resistance to possible colonization in their resistance to the computerization of land court records and other information (see the earlier section “The SoDIS Applied to this Project”).

MAORI-SPECIFIC
ETHICAL RELATA FROM THE SODIS INSPECTION

Of the issues identified in the SoDIS inspection (see the earlier section “The Results of the First Application”), several had specific significance from a Maori cultural perspective. While some of the concerns raised could be viewed as fairly relevant to any software development context, the Maori dimension often introduced further culture-specific elements.

In the first cluster of client developer communication, the key Maori ethical questions related to who could legitimately represent the iwi as the project client. Walker (1990) has noted historical situations in which the authority of the chiefs had been subverted and the authority structures of Maori society undermined by the colonizer. Thus, when engaging in research and development with Maori (Bishop, 1996), the processes of initiation and the need to work through due tribal and group decision making and authority structures are critical.

In the second cluster of sensitive data, several Maori ethical questions arose. Privacy concerns and mechanisms for obtaining consent for provision of data for genealogical research purposes raised complex questions of who could legitimately view what data. The collective ownership of whakapapa at different levels meant that group and individual access rights had to be negotiated. Individual data were personal, but whanau data were the property of the family group to decide, and hapu and iwi had their own interests and group decision-making processes in order to determine these rights. For instance, what rights would system administrators, data entry clerks, and Runanga management have to access or restrict access to this data? These policies and authorization protocols would need to be developed and agreed upon through accepted tribal decision-making processes. Similarly, protocols concerning display of cultural artifacts over the Web or use of whakapapa information for commercial purposes (e.g., to defray expenses of the site or to support storage and research costs) would need to be agreed upon at the tribal level in order to offset concerns over commercialization and inappropriate use of treasured information and sacred objects. Data integrity and the need to preserve the very authenticity of whakapapa as a stakeholder in its own right has been noted as a key Maori concern.

In the third cluster, user experience, several more Maori ethical questions arose. Again, questions over authority in disputed circum-
stances would need to be settled (i.e., who could determine official groupings and their standing?). For instance, a particular Northern group, Ngati Hine, claims iwi status but has been deemed by Te Ohu Kai Moana as a hapu. How do such determinations hold standing, who decides official lists of hapu and iwi, and how are dissenting voices to be registered? Likewise, under what criteria are membership applications to be refused registration and what is the impact for those refused? What authority will systems administrators and Runanga clerks possess, and what controls will be in place to ensure the integrity of data entered and stored? How is the integrity of whakapapa to be maintained in each of these circumstances?

Questions related to access and performance arose, with concerns over slow Internet access speeds for rural users. For indigenous peoples who often live in rural areas, access issues present known problems. Burn and Loch (2001) have observed how the digital divide particularly impacts the rural poor and rural and central city minorities. In a relatively recent report (T.P.K., 2001, p. 7), it was found that “65 percent of Maori respondents reported they had never used the internet, and about 8 percent reported they used the internet on a daily basis...only 34% of Maori households possessed a computer.”

Visual and language impairments were further concerns, with untranslated Maori language text a potential barrier for younger Maori, who would frequently be less fluent, and font selection an issue for older Maori.

Another whakapapa-related concern arose for those who were adopted (whether formally or informally) and how their data would be represented; for instance, would both natural and adoptive lineages be stored? Who would need to give consent for such a practice?

Thus, it can be seen that the SoDIS process has been able to identify concerns of particular relevance to Maori in this bicultural project. The input from Maori project participants to the SoDIS inspection seems to have resulted in an outcome whereby the Maori perspective has been incorporated successfully. This incorporation of the Maori perspective has been realized by working through the questions of the process derived from the general ethical principles identified in Table 2. While relatively generic, the questions have forced consideration of many issues critical to the stakeholders in this project. The detailed operation of the principles can be seen in the appendix to this article, which provides the full wording for each of the SoDIS principles considered relevant to Maori.

**POSSIBLE LIMITATIONS OF THE SODIS IN THE BICULTURAL CONTEXT**

**Joint Governance Models**

In her report to the New Zealand government on the issues related to online authentication and e-government, Kamira (2004) proposes joint governance models to operate in such large technology projects with potential negative impacts for Maori. The joint governance model is intended to enable power sharing between Maori and governmental agencies and to ensure that cultural differences are taken into account (i.e., the key importance of face-to-face relationships in Maori culture stands to be lost in a computerized authentication process wherein access to government services could become more alien and inaccessible to Maori users of services).

Key notions underpinning a governance-kaitiaki (guardianship) model to operate at program and project levels are drawn from the Treaty of Waitangi, the founding partnership document between the two peoples, which include:

- Active participation and participation in decision making;
- Active protection of Maori interests, rights and taonga; and
- An ongoing right to development that is not locked into an 1840 “time closet.” (Kamira, 2004, p. 35)
Thus, a general model of oversight is proposed in order to operate at a program level when an information-technology-based program of change is to be implemented in a bicultural context. While we believe that this is a sound approach to an engagement model recognizing difference and seeking partnership, we also believe that this is a difficult model for the dominant partner to adopt and to adhere to consistently.

While the SoDIS process specifically does not operate at this governance level, it can act in support of such structures by offering a mechanism for its operationalization within a project. In some cases, where a joint governance model has not been agreed upon, the SoDIS process even may compensate for its absence. For instance, the SoDIS process can act in concert with several of the following key factors indicated by Kamira (2004) for establishment of governance-kaitiaki:

- Align with the treaty (by ensuring joint participation in the analysis process);
- Encompass different cultural considerations;
- Protect the sensitivity of information;
- Ensure that ultimate accountability be to the intended beneficiaries of the project; and
- Cultivate trust and strong working relationships.

**Professionalism and Culture**

Multicultural discussions often take a “silo” approach to the description of diverse cultures, emphasizing what makes them different at the expense of complete accuracy. We have looked at the question of colonization with this approach in mind and have assumed that cultures are like a series of silos, each isolated and distinct from other cultures. Despite this presumption of difference, two such cultures, Maori and Western, seemed to interact in the application of the SoDIS inspection process to the development of a Maori software application.

The SoDIS principles are designed for the engagement of professionals in the development of software across all cultures. The SoDIS is applied within the silo in order to help the system developers to attend to the social and ethical risks within that silo. The SoDIS could be used as a tool in a paternalistic model of professionalism, where the analyst uses it to impose his or her cultural values on another; but the SoDIS was designed with a fiduciary model of professionalism in mind (Bayles, 1981). A fiduciary model of professionalism imposes high standards of development, but the resulting software is developed in partnership with the culture in which it works. Fiduciary means trust, which must be won by both partners in the endeavor.

The SoDIS provides a model for software inspection, and the values (i.e., acknowledging that whakapapa is a stakeholder) are derived from the perspective of the analyst(s) working with project stakeholders in the inspection team. In the Maori context, where models of group decision making based upon oral modes of consensus discussion (hui) are common, it could be argued that the SoDIS process needs to incorporate opportunities for such group conversations, which is certainly an area for adapting the SoDIS process and worth exploring further.

**CONCLUSION**

Although the SoDIS inspection identified some risks unique to Maori and some more general risks, it did not identify all of the risks. SoDIS, in fact, is limited in that it is not designed to identify risks arising from the interaction of multiple tasks. The application of the SoDIS process, however, has provided several interesting lessons. The application of the SoDIS process did not colonize the TRAION software project, so we can say the following:

1. The use of a Western-based development process need not colonize an indigenous software project, even using several concepts of colonize. The positive result is the following:
2. The process was able to identify some Maori unique issues. The features that facilitated this positive result are as follows:

2a. The underlying premise of the SoDIS is an analysis based on an expanded set of stakeholders.

2b. The set of principles and questions is expandable by the user and, thus, does not mandate the ethics of the analyst.

2c. The ethical questions are answered from the analyst’s perspective and subject to the analyst’s interpretation.

We believe that these lessons, gained in a bicultural context-developing software with NZ Maori, will be applicable to other indigenous peoples, especially those who have a history of colonization, such as Australian aboriginals, Native Americans, Peruvian Indians, the Inuit peoples, and so forth. In developing software for people with such differing worldviews, the careful use of software development impact statement (SoDIS) inspections may ameliorate the worst forms of recolonization by Western values through software and may enable the development of software in respectful partnerships, applying techniques that enable deep cultural differences to surface and to be addressed specifically rather than being accorded mere lip service.

REFERENCES


**ENDNOTE**

1 SoDIS is a registered trademark of the Software Development Research Foundation (SDRF).
APPENDIX. TEXT OF SODIS PRINCIPLE GUIDANCE
WITH PARTICULAR RELEVANCE TO MAORI

Principles with Particular Maori Relevance

CAUSE HARM TO

As a software project is undertaken, a central principle requires that the project and its product cause no harm, either direct or indirect. *Harm* means injury or negative consequences, such as undesirable loss of information, loss of property, property damage, or unwanted environmental impacts. This principle prohibits use of computing technology in ways that result in harm to users, the general public, employees, or employers. Harmful actions include intentional destruction or modification of files and programs leading to serious loss of resources or unnecessary expenditure of human resources, such as the time and effort required to purge systems of computer viruses. As the Association of Computing Machinery (ACM) puts it, “Well-intended actions, including those that accomplish assigned duties, may lead to harm unexpectedly. In such an event the responsible person or persons are obligated to undo or mitigate the negative consequences as much as possible. One way to avoid unintentional harm is to carefully consider potential impacts on all those affected by decisions made during design and implementation” (ACM).

CAUSE Loss of Information, Loss of Property, Property Damage, or Environmental Impacts

Software can harm property and the environment directly and indirectly. Examples might include software that regulates chemicals or machine control software and financial systems. The task should be evaluated in light of the current stakeholder’s interests.

INVOLVE the Design or Approval of Software that Will Not Lower the Quality of Life

Software first should not harm and, if possible, should improve the quality of life. Each task should be evaluated to determine the effect it will have on the quality of life of each relevant stakeholder. Examples of diminished quality of life could include applications that cause repetitive strain injuries, the inability of customers to return unwanted or damaged merchandise, or software-controlled machinery that is excessively noisy.

FAIL to Take into Consideration the Needs of

Software tasks, projects, and products often are completed without considering the needs of certain stakeholders. The omission of these considerations can lead to mediocre software, disgruntled stakeholders, and, in the worst case, unacceptable products.

(continued on next page)
Codified, systematic discrimination can damage entire demographic groups and, in the worst cases, result in class-action litigation. Health insurance or life insurance eligibility software, for example, inadvertently can discriminate against persons from certain economic backgrounds. Single-language automated teller machines can prevent groups from getting access to their accounts. Each task should be evaluated to determine whether its outcome might discriminate against the current stakeholder.

Could the current task compromise the privacy or confidentiality of the current stakeholder? If so, what steps must be taken to ensure that the stakeholder’s needs will be considered and resolved?

Could the current task compromise the information security of the current stakeholder? If so, what steps must be taken to ensure that the stakeholder’s needs will be considered and resolved?

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Tony Clear is associate head of school (Industry & Development) for the School of Computer and Information Sciences at Auckland University of Technology. Prior to entering academia he worked in industry as a practicing software development manager. His current teaching responsibilities include coordinating the capstone projects in the bachelor’s of computer & information Sciences. His research interests include software development and IT professionalism, computing education and research, and investigating phenomena related to collaborative technologies and global virtual teams. He chairs the Research and Support working group for the New Zealand National Advisory Committee on Computing Qualifications, is a member of the editorial board of the Bulletin of Applied Computing and IT, and contributes “ThinkingISSues” a regular column for the ACM SIGCSE Bulletin. Through family links he has tribal affiliations to the Tainui and Ngapuhi iwi.
Wayne Gray is currently working as a Web developer/programmer for The University of Auckland Business School. He completed a bachelor’s of information technology at Auckland University of Technology in 2004, during which he was involved in the continuation of a previous student project which focused on the creation of an Iwi (Tribal) Membership system. One portion of the project included a SoDIS inspection with the help of a master’s student to facilitate the process. He is also currently implementing a community Web site for the Software Engineering Practice Improvement Alliance, which is due to be up and running in early December 2005. He is a member of the Ngati Haua sub-tribe of the Waikato Iwi.

Bryan Houliston recently completed a master’s in information technology at Auckland University of Technology. His major research interest is ubiquitous — mobile, ad-hoc, and wireless — networks, and his dissertation is on the application of RFID technology in hospitals. Prior to this period of study he spent 10 years as a professional software developer. Since graduating he has returned to industry, with the intention of continuing to promote SoDIS principles within the development community.
Discussion on Article 1: 
A Māori Perspective on 
Bicultural Software Development

Te Taka Keegan, University of Waikato, New Zealand

I would like to congratulate the authors of this article for attempting to undertake software development impact analysis in a bicultural context. This article does raise some interesting issues, and I would like to comment on some of them from just one perspective, that of the indigenous Māori viewpoint.

Before I begin, I would like to comment on the frequent usage of the word *colonisation*. I think this is an unfortunate term to use, unless it is well defined, as it can mean quite different things to different people. For example, to the colonisers it is a positive process; to the people being colonised, it is usually a negative process. Perhaps this article uses the word *colonisation* to mean the denial, exclusion, and suppression of one culture?

It appears that at the heart of the SoDIS process is the definition of some basic moral rules. These rules carry with them corresponding sets of rights, and these rights, in turn, can be used to identify the key stakeholders. Once the stakeholders have been identified, their rights and obligations also can be identified and matched with the tasks that the software undertakes to determine risks and issues of concern.

I am surprised that some Māori moral rules were not considered and implemented into the process. I am a member of a Māori tribal organisation that read some basic (Māori) rules before each meeting. The following are examples of two of these rules:

- *manaakitia te tangaia i ngā wā katoa* (All people are to be treated with respect and courtesy at all time)
- *he tapu rawa atu te kai, te inu me te momi hikareti* (no smoking or consumption of food or drink)

While on the surface, these two moral rules may appear similar to those espoused in this article, I would like to suggest, however, that they are more involved and can give rise to issues of concern that otherwise may not be considered. For example, *manaaki tangata* is literally raising the *mana* and prestige of (other) people; it’s about treating people with respect, of raising their importance and needs above yours, of looking after their health and well being, often to the detriment of your own needs. I believe that it goes further than the Western notion of “do unto others as you would have others do unto you.” Perhaps it could be elucidated as “treat others as kings, and you will, in turn, be considered a king.”

One of the most fundamental rules in tikanga Māori (Māori customs) is the notion of *tapu* (sacredness), as alluded to in the second rule, example mentioned previously. Defining articles as *tapu* sets boundaries and serves as a traditional risk management system. The partaking of eating, drinking, and smoking while our meeting is in session is prohibited, and consequently, the treasure of discussion and the dissemination of knowledge is given its due importance and protection.
Whakapapa (genealogy) is defined in this article as a stakeholder, so concerns and issues in its usage can be raised. I question this, as I see whakapapa as an intrinsic part of all stakeholders. Moreover, if the SoDIS process is able to assert the moral rule of tapu to whakapapa, then the opposite concerns and issues will be raised at the appropriate stage in the evaluation process.

When considering stakeholders from a Māori perspective, the most important would be the iwi (large tribal group), followed by the hapū (subtribe), followed by the whānau (family group), and finally, the tangata (individual). Having all these groups as stakeholders and allocating priorities accordingly would help to reduce the individualistic worldview mentality under which the SoDIS system was developed.

An important stakeholder that I would not omit is the Māori language. Language and culture are so intertwined that they are inseparable. An impact on the language is an impact on the culture, and vice versa. If the interface of the software were only in English, then this would lead to marginalisation of the Māori language and, consequently, a suppression of the Māori culture. Māori language as a stakeholder raises potential risks with regard to orthography, terminology, consistency, and the ability to be understood. Further, if the iwi were rated as the most important stakeholder, then the interface predominantly would be in the language of the iwi. The consideration given to tribal members who could not speak the language would rate as less important.

The article suggests that the SoDIS analysis did not impose Western social values. With the examples that I have raised, I would like to suggest that the analysis did not integrate some important indigenous social values, either. However, what’s promising is that the SoDIS process indeed may have the ability to incorporate indigenous values, if a critical component is added. There must be appropriate indigenous control in all aspects of the SoDIS process, from the defining of moral rules and the subsequent principles, the defining of the entities and relationships, the defining of tasks and issues, to the final stages of risk analysis and management. If this occurs, then I am confident that the SoDIS process may be able to identify software development risks in an indigenous context.

If the system is proven in an indigenous context, then there is every possibility that it also could be incorporated into a bicultural context.

Te Taka Keegan is of Waikato-Maniapoto and Ngati Porou descent. He received a diploma in computer engineering from the Central Institute of Technology in Wellington and an MA from the University of Waikato through the Tohu Paetahi (Māori language) stream. Since 1994 he has been lecturing on computer science in te reo Māori at the University of Waikato. His research interests are primarily involved with the use of the Māori language in the computing and Internet environments.