issue. Another recommendation is to adopt more quantitative measures, such as research output and student output, to address the "soft criteria" issue.

One such quantitative measure for research output is publications. Typically, a publication-based ranking chooses a research field, selects a group of publication venues that are considered prestigious, representative, and influential for the field, assigns a score to each paper an institution or an author has published, and ranks institutions and authors using sums of the scores. In the computer science field, the latest publication-based ranking of different institutions was finished in 1996 by Geist et al. [4]. They selected 17 archival research journals published by ACM or IEEE, giving one point to each paper appearing in a journal from January 1990 to May 1995. In the systems and software engineering field, the *Journal of Systems and Software* (JSS) has been publishing an annual publication-based assessment of scholars and institutions since 1994 [9]. (Henceforth, this assessment will be referred to as the JSS ranking). Each year the JSS ranking was based on papers published in the previous five years. The rankings used six journals selected by a 1991 survey of the JSS editorial board.

Assessing research institutions and scholars is a complex social and scientific process. While publication-based ranking can be used alone, it should probably serve as one quantitative indicator in a more comprehensive methodology because an assessment of institutions solely based on publications does not effectively reflect other important factors such as student quality, research funding, or impact.

Existing publication-based rankings have several limitations. One major limitation is the fact they are usually performed manually. As a result, both the number of journals considered and the time span over which the papers are assessed is limited, reducing the scope of such rankings. Ranking manually may also be the reason for considering journals exclusively and neglecting other important sources of academic communication such as conference proceedings. A second limitation is that reported rankings are limited to specific fields. Each new research field requires the construction of a new ranking system that manually repeats the same basic procedure. The previous two limitations yield a third one, that of inflexible criteria. For example, both rankings noted here made different decisions about what journals were included and how each paper was scored. While the decisions were originally made for legitimate reasons, the criteria cannot be altered without repeating the entire labor-intensive process. These limitations hinder the applicability of publication-based ranking.

### Accommodating Flexible Policies

To overcome these limitations, we developed a framework that facilitates automatic and versatile publication-based ranking. It utilizes electronic bibliographic data to process a broader range of journals and conferences spanning periods longer than those previously used. This framework can accommodate many policy choices.

The contribution of this framework is not to provide yet another ranking result or methodology. Instead, we enhance traditional publication-based ranking by supplying a policy-neutral automatic mechanism that can be utilized with various choices. When combined with well-designed criteria, this framework can provide results comparable to those produced by manual processes, with reduced cost and wider applicability. Such results can be used as an additional data point in a more comprehensive assessment. However, it is the evaluator who decides whether to adopt a publication-based ranking scheme and, if so, how to conduct such a ranking with the framework.

The general steps in a publication-based ranking are:

1. Choose a field;
2. Select representative publication venues for the field and, optionally, assign a weight to each venue;
3. Set the time range for consideration;
4. Assign a score to each published paper, possibly biased by the venue's weight;
5. Divide the score among multiple authors if the paper has more than one author;
6. Sum the scores for each scholar and each institution; and finally,
7. Rank the scholars and institutions based on sums of their scores.

The most important policy decisions involved in this process are the following:

*What field to rank?* The field can be the whole field, such as all of computer science, or it can be a subfield, like systems and software engineering, as in [4] and [9], respectively. Our framework supports both choices. Any science and engineering discipline can be ranked by the framework, as long as journal and conference publications are considered an effective assessment of scholarship in that field and bibliographic data for the field is available. This framework does not apply well to