# I. INTRODUCTION

When Koichi Kitazawa and Paul Chu independently announced confirmation of the high temperature superconductivity phenomena at the Materials Research Society Conference on December 4, 1986, they ignited the international development of a new field. It was an unanticipated and a major breakthrough which offered an array of possibilities and questions to be answered. How high would the temperature go? Could these materials be processed into useful devices? What was the cause of the phenomena?

For science, the discovery posed a challenge to well established theories of the mechanisms of superconductivity. Accepted theories did not predict this phenomena and did not provide a guide of how to proceed. For the industry, and for consumers, the discovery offered new hope for the possibility that superconductors might yet come into widespread common use, affecting a wide range of activities ranging from vehicle transportation, to energy conversion and storage, to information processing, to medical and material diagnostics.

The sudden emergence of high temperature superconductivity provides an opportunity to examine the response of public and private institutions to a major unexpected breakthrough which at least for a brief time captured the attention of scientists, industrialisits, and policymakers. It provides a chance to see how policies take shape as various arms of the bureaucracy vie for a role in its development, and as various firms and laboratories move to position themselves in the industry. And it provides a chance to view the use of cooperative R&D as institutions move to strengthen themselves quickly in this area.

High temperature superconductivity did not, however, occur in a technological vacuum as there did exist an established superconductivity industry in Japan which had developed over the previous 20 years. It was an industry which was reared over a history of large engineering projects, and is a history which is itself revealing of the uses of consortia for technology development.

In this chapter I will be examining the role of government policy in support of innovation and the role of R&D alliances through research and development projects in both high temperature and traditional low temperature superconductivity.

Throughout this section the history, analysis of the industry, and case studies area all conducted with an intent to examine how these projects are created, how they are organized and executed, and what impact the activities have on the technology or industry.

Dividing these projects between the high temperature and low temperature cases allows a contrast of the use of consortia to support projects which are primarily a technological or engineering challenge, those involving low temperature superconductivity (LTS), and projects which are a scientific challenge, those involving high temperature superconductivity (HTS). Examining the low temperature cases also allows for an opportunity to view the influence of differing technological characteristics such as scale and complexity on the operation of consortia.

This report is divided into nine sections. Following this introduction, the second section provides a brief introduction to the technology, its applications and potential applications, and the problems faced in its development. The third section presents a discussion oft he history of the superconductivity industry in Japan up to 1986.

This section will illustrate the early role of government programs and consortia in pursuing superconductivity, relationships established, and the development of the major laboratories and technologies. The fourth section contains a review of the status of the industry and of industrial relationships at the time of the discovery of HTS. This is followed in the fifth section by an examination of the timing and magnitude of the response of the industry and of the government to the HTS discovery, asking how well the latter seems to support the former. After this review the discussion will move to an analysis of specific cases in collaborative R&D in Sections Six and Seven. The two cases in HTS collaboration focussed on here are the International Superconductivity Technology Center (ISTEO and the Multi-Core Program. The seventh section is an analysis of cases from LTS R&D.

These cases provide the opportunity for examining in more detail the issues of formation, organization, and impact in a less fevered environment. In the eighth section I touch on the issue of collaboration in R&D generally in superconductivity to examine more broadly how collaboration has been used to promote innovation, and conclude with a general summary in Section Nine.