



NDSU
researTECHNOLOGY PARK INC.

IMPACT STUDY

NDSU Research and Technology Park

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Executive Summary

The North Dakota State University (NDSU) Research and Technology Park (RTP), located on 55 acres in Fargo, ND, serves as a business incubation and commercialization contributor to the local and regional economy. Economic Modeling Specialists Inc. (EMSI) produced the following economic impact study based on data provided by the individual businesses in the RTP combined with data embedded in EMSI's Analyst tool.

Since 2001, construction and maintenance of the RTP have provided 41 direct plus 49 indirect jobs per year (for a total of 90 jobs per year), creating a cumulative labor income of nearly \$49 million. More enduring are the jobs and income created in the 19 businesses located at the RTP. All together, these account for 893 direct on-site jobs, and another 551 indirect off-site jobs, for a total of 1,444 North Dakota jobs.

RTP industries pay salaries averaging \$57 thousand per year, while associated multiplier effect industries (i.e., industries outside the RTP but in North Dakota) pay salaries averaging \$41 thousand per year. In terms of total labor income, RTP industries pay out nearly \$51 million in wages and, as a result of multiplier effects, account for another \$23 million in indirect off-site wages. Summing direct and indirect yields, RTP labor income impact totals some \$73.6 million in North Dakota labor income.

There is more. RTP and associated multiplier-effect industries create non-labor (property) income—a broad measure that includes retained earnings, dividends, interest and bond payments, and depreciation allowances. Overall, it is estimated that RTP industries generate property incomes of just over \$11 million, while off-site but linked businesses see property incomes of just over \$17

million. Altogether, RTP industries directly or indirectly account for just over \$28.4 million in property income in North Dakota.

RTP direct and multiplier-related incomes expand the tax bases of local and state governments. It is estimated that the RTP directly and indirectly generates just over \$3.6 million in local government revenues, including just over \$2.4 million in property tax revenues, and another \$1.2 million in other taxes, charges and fees. The state government impact is greater. It is estimated that the RTP directly and indirectly generates \$7.3 million in state government revenues, including some \$2.6 million in sales tax revenues, \$1.5 million in personal and corporate state income tax receipts, and \$3.2 million in miscellaneous state taxes, charges, fees and general revenues. Altogether, RTP and associated activities annually account for nearly \$11 million in state and local government revenues.

EMSI conducted a limited analysis of the effectiveness of RTP company investments. Four of the 19 RTP companies earn royalty and/or license revenues. The benefit/cost (B/C) ratio for these projects shows that for every dollar of costs incurred, the companies earn \$2.80 in present value terms, a strongly positive and feasible return on investment.

The overall picture indicated by EMSI's look at the RTP is one of strong economic performance, significant job and income creating effects, and a substantial contributor to North Dakota's tax base, both state and local. Further growth at the park will contribute not only to the Fargo economy, but elsewhere in the state through economic multiplier effects.

1. Introduction

1.1 Background

The North Dakota State University (NDSU) Research and Technology Park (RTP), located on 55 acres in Fargo, ND, serves as a business incubation and commercialization contributor to the local and regional economy. Economic Modeling Specialists Inc. (EMSI) has been tasked with providing an impact study of the RTP based on data provided by the individual businesses in the RTP combined with data embedded in EMSI’s Analyst, a tool used to compute multipliers and total economic impacts (see “Data Sources” at the end of this report).

The current tenants included in this analysis are listed in Table 1, along with their corresponding North American Industrial Classification System (NAICS) codes and summary descriptions. Several of these are start-up

companies, while others are well established and already generating revenues far above their costs. All of the data sources are listed at the end of this report.

The impact results presented in this report are based, to every extent possible, on data obtained from the participating companies. Several companies, however, did not submit complete data sets, predominantly for privacy reasons. Some companies, for example, reported costs but not revenues. Other companies did not submit consistent employment data, e.g., they did not provide the breakout between full- and part-time employees and the corresponding earnings differentials. For some companies, no data on NDSU undergraduate or graduate student employment were submitted. In all of these cases, the data gaps were filled in with data from EMSI’s comprehensive databases for industry, occupation, and

Table 1: Participating RTP Companies

RTP Companies	NAICS ¹	NAICS Descriptions
1 Research Foundation	541990	Professional, Scientific, and Technical Services
2 Research 1-Polymers	325211	Plastics Material and Resin Manufacturing
3 RCATT	611310	Colleges, Universities, and Professional Schools
4 RTP Incubator	712190	Nature Parks and Other Similar Institutions
5 Appareo	336411	Aircraft Manufacturing
6 Pedigree	541511	Custom Computer Programming Services
7 Phoenix International	334419	Other Electronic Component Manufacturing
8 Candlewood	721110	Hotels (except Casino Hotels) and Motels
9 Intelligent Insites	541511	Custom Computer Programming Services
10 Bolder Thinking	541511	Custom Computer Programming Services
11 Avenue Right	519190	All Other Information Services
12 Triton Systems	325998	Misc. Chemical Product, Preparation Manufacturing
13 Feed Mgt. Systems	424910	Farm Supplies Merchant Wholesalers
14 Bobcat	333111	Farm Machinery and Equipment Manufacturing
15 Larada Sciences	334510	Electromedical/Electrotherapeutic Apparatus Mfg
16 Genosys	541711	Research and Development in Biotechnology
17 Myriad Devices	541512	Computer Systems Design Services
18 Formula Now	541712	Computer Systems Design Services
19 Ergologistics	541420	Industrial Design Services

Source: Data submitted by RTP companies.

¹ North American Industry Classification System

staffing patterns in order to derive approximate impact measures. These data adjustments are described in the narrative of the report.

The report has four chapters and one appendix. Chapter 1 highlights the approach to the study, including the analytical approach and the kinds of data collected, as well as a brief description of EMSI's input-output (IO) model. Chapter 2 presents the bulk of the results, including the estimated construction impacts, employment and income impacts, and RTP's estimated fiscal impacts on state and local government revenues. Also included in the results (in the simplest of terms because of data limitations) is the return on investment (ROI) of the companies that report royalty revenues. Chapter 3 delves into the international market and the economic impacts that can be linked to goods and services emanating from the RTP companies. Chapter 4 provides an overview of cash infusions from outside grants, venture capital, and angel investors.

1.2 Purpose

The purpose of this project is to describe and measure the impacts generated as a result of the RTP as a whole. Specifically, this report seeks to measure impacts of building construction and maintenance, employment and earnings,¹ and contributions to the local tax base. Of those companies that have created royalty and licensing revenue, the report seeks to examine their return on investment. In addition, the report aims to provide an understanding of the economic footprint of RTP's activities on out-of-state and international economies, as well as how these outside economies contribute to local employment, earnings, and tax revenues. Finally, the ability to secure external grants and investment is summarized over time.

1.3 Approach

NDSU provided data on the basic operations of RTP businesses, as well as data on jobs and payrolls. Together, these constitute the "on-site" or "direct" effects of the RTP. Economic effects (impacts) do not stop here, however.

¹ Standard usage defines "earnings" as the sum of wages, salaries and proprietors' income. Earnings are frequently referred to as "labor income".

Businesses purchase inputs from other businesses and, to the extent that these are North Dakota businesses, therefore create additional jobs and incomes. Likewise, RTP employees purchase consumer goods and services, thereby supporting other North Dakota businesses. In turn, these "indirectly" impacted businesses purchase inputs and pay employees themselves, leading to additional rounds of business activity. In the language of regional economics, the on-site RTP activities set up a multiplier effect of additional activities. The total RTP impact is the sum of its on-site jobs and incomes (the direct impact) plus the additional off-site multiplier jobs and incomes (the indirect impact).

The estimation of multiplier effects in North Dakota's economy requires the construction of an economic model, specifically an IO model. Details on the IO model used in this study are provided later in section 1.3.2, as well as in Appendix 1.

Another important impact of the RTP is the fiscal impact due to the state and local tax revenues it generates. This impact is created in two ways—directly and indirectly. The "direct" or "on-site" impact occurs when RTP businesses and employees pay taxes. "Indirect" or "off-site" taxes are also generated in other businesses as a result of multiplier effects. The estimation of the tax impacts required construction of a North Dakota fiscal impact model—see section 1.3.3 below for details.

The overall economic impact of the RTP is reported as total jobs (direct and indirect) total labor and property income (direct and indirect), and the sums of state and local government tax receipts generated as a result of the above-mentioned income effects.

1.3.1 Data Collection

Data collected from the RTP companies shown in Table 1 were parsed into five categories; these are summarized in Table 2. Categories include the following: 1) employment and earnings, 2) expenditures (costs), 3) revenues, 4) debt and equity estimates, and 5) construction costs. Of these, the employment and earnings data set was incomplete due to several companies not providing the details on part- and full-time employees, whether NDSU data were students or graduates, or whether employees were out-of-state or local (non-NDSU) employees. Earnings data were likewise incomplete, which required the use of EMSI's databases in some cases to estimate average regional earnings corresponding to the appropriate NAICS codes.

The cost data were largely complete for all of the com-

Table 2: Data Collected

1. Employment and Earnings	
Total Number of Employees	
Full Time Employees	
Part Time Employees	
Secondary Employment Estimate	
NDSU Graduates Employed	
NDSU Students Employed	
Employees Recruited from Out of State	
Average Salaries of Employees (Full Time)	
Average Salaries of Employees (Part Time)	
2. Expenditures Estimate (Costs)	
Equipment	
Payroll	
Contracts and Supplies Purchases	
Research Expenditures	
Royalty Distributions	
Other – Legal	
Other – Misc	
3. Cash Inflow History (Revenues)	
Royalty Revenue	
Licensing Revenue	
Revenue – NDSU	
Revenue – In State	
Revenue – Out of State (U.S.)	
Revenue – International (List Countries)	
Other	
4. Debt/Equity	
Debt	
Equity	
Grants, VC Funds, Angel Funds	
Other – Net Gain/Loss on Investment	
5. Facility Construction	
Industrial	
Commercial	
Maintenance (Landscaping, Roofing)	
Other	

Source: Data submitted by participating RTP companies.

panies, but the revenue data were not. Several companies omitted revenue data, ostensibly for privacy reasons. In these cases, EMSI’s regional data were used to estimate earnings for the companies by the corresponding NAICS codes in order to generate the impact measures.

The data received on employment sources (*i.e.*, NDSU full- and part-time students and graduates, workers recruited from out-of-state, and workers recruited from inside the region but not from the university) were incom-

plete but still sufficient enough to derive fairly accurate direct and indirect jobs estimates.

Debt and equity estimates were not provided by the majority of the RTP tenants. Since financial accounting is not publicly available for non-publicly traded companies, measures of financial health were not accessible. However, since the majority of tenants were involved in activities that are not capital intensive, it is reasonable to assume that debt/equity ratios may be lower than 1.

1.3.2 Input / Output Model

IO analysis is a fundamental branch of regional economics with roots in economic theory that date to the 18th century. EMSI constructs its IO model using standard data sources and modeling techniques. Additional details on EMSI’s IO model are provided in Appendix 1.

The term “input-output” stems from the fact that the inputs of one industry are in part made up of the outputs of other industries. A computer software designer located in North Dakota might purchase computer hardware, as well as accounting and legal services from North Dakota sources. He or she thus uses the outputs of North Dakota companies as the inputs for his or her own company. Using a comprehensive “input-output table,” the North Dakota IO model tracks the output sales and input purchases for all industries, agriculture, construction, manufacturing, services, and governments in the state.

The IO table is transformed into an IO model, and this provides the vehicle for tracking the indirect jobs and incomes associated with on-site RTP activity.²

1.3.3 Fiscal Impact Model

A key measure in assessing the economic importance of the RTP is determining its impact on the local and state government tax base. That impact is measured in a simple yet fundamental sense, *i.e.*, in terms of the various state and local tax revenues generated as the result of RTP activities.

The North Dakota fiscal impact model takes the tradi-

² Fargo is located on North Dakota’s border with Minnesota. This requires some adjustment in the state-level multiplier use in this study. In particular, multiplier effects that might stay in-state in the case of more centrally located places will spill out of state in the case of Fargo. Borrowing from other studies of spillover effects, statewide multipliers have been adjusted downward by approximately one-quarter to account for Fargo spillovers to Minnesota and elsewhere.

tional linear average-tax form. Consider property taxes—in North Dakota, property taxes are mainly collected by local government based on the overall assessed value of personal and business property. Note that these assessed values will move in a direct and positive fashion with the level of overall income. When business incomes increase, property values increase. This is because property values are derived in part from the present value of anticipated future incomes. With increased business income, businesses tend to invest more, which directly raises business property values.

Personal property values show a similar pattern. Increased labor income tends to lead to home improve-

ment and a filtering up of real estate, *i.e.*, families with an increasing income will often move into more expensive homes. EMSI captures the relationship between business/personal incomes and business/personal property taxes by forming a set of coefficients, then showing total state and local property tax collections divided by total labor and non-labor (*i.e.*, property) incomes. When there is a change in incomes, EMSI applies the property tax coefficients to yield corresponding measures of tax revenues. Thus, for this report, if RTP businesses have a change in income, EMSI has calculated the resulting projected change in tax revenues.

2. Impact Analysis

2.1 Introduction

In this chapter, the economic impact of the RTP is examined according to the following four key measures: 1) jobs, 2) labor income, 3) non-labor (property) income, and 4) local and state tax revenues. Jobs and incomes are created on-site at the firms located within the RTP, and off-site at firms located throughout North Dakota. These off-site jobs and incomes occur through the action of familiar economic multiplier effects. Added tax revenues stem from the added labor and non-labor income, both at the RTP and elsewhere.

Another form of economic impact refers to the effectiveness of RTP company investments in research and product development. Using figures provided by RTP tenants, the return on research and product development investments are considered using standard discounted benefit-cost methods.

2.2 Construction Impacts

Construction and maintenance of the RTP are investments made in and by the local community. Although construction jobs and related earnings on specific new building projects are temporary, as the park continues to grow, new construction has supported employment through the years. Additionally, regular maintenance supports stable employment, and the park's expansion will support additional maintenance jobs.

Table 3 presents industrial and commercial new and maintenance construction expenditures from 2001 to 2011. The data from 2001 to 2006 were compiled from data already published, while data from 2007 to 2010 were collected by EMSI from RTP tenants. Figures for 2011 were projected.

Over the 10-year time frame, construction expenditures provided an average of 41 direct jobs per year and

Table 3: Construction jobs and Earnings (\$1,000)

Year	Expenditures	Jobs			Earnings			
		Direct	Indirect	TOTAL	Direct	Indirect	TOTAL	
2001	Industrial	\$5,251	31	41	72	\$2,388	\$1,421	\$3,809
	Commercial	\$0	0	0	0	\$0	\$0	\$0
	Maintenance	\$0	0	1	1	\$0	\$0	\$0
2002	Industrial	\$6,406	38	50	88	\$2,914	\$1,734	\$4,648
	Commercial	\$0	0	0	0	\$0	\$0	\$0
	Maintenance	\$0	0	1	1	\$0	\$0	\$0
2003	Industrial	\$0	0	0	0	\$0	\$0	\$0
	Commercial	\$0	0	0	0	\$0	\$0	\$0
	Maintenance	\$219	3	1	4	\$100	\$59	\$159
2004	Industrial	\$34,581	204	272	476	\$15,728	\$9,360	\$25,088
	Commercial	\$0	0	0	0	\$0	\$0	\$0
	Maintenance	\$364	4	1	5	\$166	\$98	\$264
2005	Industrial	\$0	0	0	0	\$0	\$0	\$0
	Commercial	\$4,205	26	22	48	\$1,913	\$1,156	\$3,069
	Maintenance	\$292	4	1	5	\$133	\$78	\$211
2006	Industrial	\$4,621	27	36	64	\$2,102	\$1,251	\$3,353
	Commercial	\$0	0	0	0	\$0	\$0	\$0

Table 3: Construction jobs and Earnings (\$1,000)

Year	Expenditures	Jobs			Earnings			
		Direct	Indirect	TOTAL	Direct	Indirect	TOTAL	
2007	Maintenance	\$175	2	1	3	\$80	\$47	\$127
	Industrial	\$50	1	1	2	\$23	\$14	\$37
	Commercial	\$7,064	44	37	81	\$3,213	\$1,941	\$5,154
2008	Maintenance	\$49	1	0	1	\$22	\$13	\$35
	Industrial	\$14	1	1	2	\$6	\$4	\$10
	Commercial	\$804	5	4	9	\$366	\$221	\$587
2009	Maintenance	\$67	1	0	1	\$31	\$18	\$49
	Industrial	\$0	0	0	0	\$0	\$0	\$0
	Commercial	\$2,288	14	12	26	\$1,040	\$629	\$1,669
2010	Maintenance	\$278	3	2	5	\$126	\$75	\$201
	Industrial	\$0	0	0	0	\$0	\$0	\$0
	Commercial	\$0	0	0	0	\$0	\$0	\$0
2011*	Maintenance	\$59	1	1	2	\$27	\$16	\$43
	Industrial	\$0	0	0	0	\$0	\$0	\$0
	Commercial	\$0	0	0	0	\$0	\$0	\$0
	Maintenance	\$103	1	1	2	\$47	\$28	\$75
TOTAL	\$66,890	NA	NA	NA	\$30,425	\$18,163	\$48,588	

created cumulative earnings of \$30.4 million.³ The direct jobs and associated expenditures indirectly supported an approximate additional 49 jobs per year with corresponding cumulative earnings of \$18.2 million. Altogether, new and maintenance construction in the park supported an average of 90 jobs per year with total 10-year cumulative earnings of nearly \$49 million.

2.3 Employment and Income Impacts

This section aims to show the overall job and income impacts of the RTP. These impacts include the job and labor income reported by the various RTP tenants, plus added jobs and income beyond the RTP felt elsewhere in North Dakota as a result of the multiplier effects. Component data from the EMSI IO model are also used to estimate direct and indirect non-labor (property) income. The sum of the RTP's contribution to labor and non-labor income represents its contribution to North Dakota Gross State Product (GSP).

Table 4 presents RTP's impact on jobs with details on NDSU students and graduates, workers recruited from out-of-state and other locally hired employees (each with its own respective column). These values were collected from the RTP tenants themselves and summed to equal

³ The total in the "Jobs" "Direct" column is 411 divided by 10 years equals 41 jobs.

"total direct" employment (the on-site jobs). Next, the total number of jobs created "indirectly" is calculated. The "grand total" of job creation equals the direct plus the indirect jobs created by the RTP.

The 551 "indirect" workers are calculated using the North Dakota EMSI IO model.⁴ These represent jobs outside the RTP generated through business input and RTP tenant employee consumer spending. The "Grand Total" is the sum of direct plus indirect jobs. Altogether, the RTP accounts for 893 direct on-site jobs, as well as another 551 indirect off-site (but still North Dakota) jobs. All told,

Table 4: Employment Impacts

Employment Impacts	Employees
NDSU Students	138
NDSU Graduates	286
Out-of-State Employees	23
Other Local	446
Total Direct	893
Indirect	551
Grand total	1,444

Source: Data submitted by RTP companies and outputs of the EMSI North Dakota IO model.

⁴ In technical input-output literature, "indirect" represents the effect of business input spending, while "induced" represents the effect of consumer-from-wages spending. In common practice (and in this report), however, both indirect and induced effects are commonly lumped together as "indirect effects."

the RTP accounts for 1,444 North Dakota jobs.

Table 5 presents the income effects of the RTP. First, the table shows the average salaries expressed as “Direct” (salaries paid by RTP tenants to their employees) and “Indirect” (salaries paid in economically-linked industries that provide goods and services as inputs to the RTP companies). The latter refers to the industries linked by virtue of the multiplier effects. In all, the tenants of the RTP pay salaries averaging \$57 thousand per year, while associated multiplier effect industries pay salaries averaging \$41 thousand per year. The overall weighted salary of the participating companies (direct) plus indirect industries is nearly \$51 thousand per year.

Table 5: Income Effects (\$1,000)

Average salary	Direct	\$57
	Indirect	\$41
	Total	\$51
Total labor income	Direct	\$50,858
	Indirect	\$22,708
	Total	\$73,566
Total property income	Direct	\$11,226
	Indirect	\$17,195
	Total	\$28,421

Source: Data submitted by participating RTP companies and outputs of the EMSI North Dakota IO model.

Next, the table shows the impact of the RTP on total labor income (earnings: wages, salaries and proprietors’ incomes). The data are the product of reported total jobs and average annual salaries. The “indirect” refers to the number of jobs reported stemming from associated multiplier effects. These are estimated from the EMSI IO model. The total is the sum of the direct plus indirect effects, thus giving the total impact of the RTP tenant companies on labor income in North Dakota.

Altogether, RTP industries pay some \$50.8 million in wages, and generate another \$22.7 million in wages off-site as a result of multiplier effects. The total is yielded by summing the direct and indirect—the RTP accounts for \$73.6 million in labor income in North Dakota.

In regional income accounting terminology, “property income” measures gross operating margins, including allowance for capital depreciation. This is a broad measure of income that includes retained earnings, dividend interest and bond payments, and depreciation allowances. The sum of labor plus non-labor income approximately equals value added, which in turn approximately equals gross state product.

Property incomes were obtained from component

data in the EMSI IO model in addition to data supplied by RTP tenants. For example, the EMSI IO model shows the statewide average ratio of property income to labor income. These ratios are applied to the labor income reported by RTP tenants to arrive at the property income estimates reported in Table 5. The RTP industries generate overall property incomes of just over \$11 million, while off-site but linked businesses see property values of just over \$17 million. Altogether, RTP industries directly or indirectly account for \$28.4 million in property income in North Dakota.

2.4 Fiscal Effects: Contributions to ND’s Tax Base

Section 1.3.3 above describes the fiscal impact model built to analyze the tax-generating impacts of the RTP. In this section, the fiscal impact model is coupled with job and income effects detailed in the previous section (Table 5).

Table 6 summarizes the effects of jobs and incomes shown in Table 5. It then presents the associated impact on state and local government tax revenues. It is estimated that the RTP and its associated economic activity lead to the creation of nearly \$2.4 million in local government property tax receipts, approximately \$313 thousand in sales and gross receipts taxes, some \$49 thousand in other taxes and fees, and \$866 thousand in miscellaneous charges and general revenues. Altogether,

Table 6: Summary of Economic and Fiscal Effects

Summary economic effects	
Jobs	1,444
Labor income (\$1,000)	\$73,566
Property income (\$1,000)	\$28,421
Summary of local government revenue effects	
Property tax (\$1,000)	\$2,400
Sales and gross receipts (\$1,000)	\$313
Other local taxes and fees (\$1,000)	\$49
Misc. charges and gen rev (\$1,000)	\$866
Total	\$3,628
Summary of state government revenue effects	
Sales and gross receipts (\$1,000)	\$2,555
Individual income (\$1,000)	\$1,107
Corporate income (\$1,000)	\$447
Other state taxes and fees (\$1,000)	\$1,401
Misc charges and gen rev (\$1,000)	\$1,810
Total	\$7,320
Grand total, state and local taxes	\$10,948

RTP and associated activities account for just over \$3.6 million in local government revenues.

Similarly, RTP jobs and incomes contribute to the creation of state government tax revenues. It is estimated that the RTP and its associated economic activities lead to the creation of nearly \$2.6 million in state government sales and gross receipts taxes, just over \$1.1 million in individual income tax receipts, approximately \$447 thousand corporate income tax receipts, and some \$3.2 million in other taxes and fees, miscellaneous charges and general revenues. Altogether, RTP and associated activities account for just over \$7.3 million in state government revenues.

Local and state government fiscal effects can now be summarized as the RTP creating just under \$11 million in state and local tax creation.

2.5 Return on Investment

EMSI was given the task of measuring the ROI for any research expenditure which generated licensing and/or royalty revenues over the past four years. Four of the nineteen RTP companies earn royalty and/or license revenues. Based on the data submitted, a simple cash flow model was used to measure the ROI since 2007. This is expressed as a net present value (NPV) or benefit/cost ratio (B/C). The ROI includes projected revenues to be earned in 2011.⁵

In Table 7, all costs and benefits are included in the aggregate (from all four of these companies), including equipment, payroll, supplies, research expenditures and other costs. Likewise, all of the following benefits (revenues) are included: royalty and licensing revenues, revenues from NDSU, in-state, out-of-state, and international revenues plus other (non-identified) revenues.

The most well-known and commonly used evaluation

criterion for any investment is the net present value (NPV). As the words indicate, NPV is a measure of the net benefits (benefits minus costs) stated in present value terms. Obviously, one cannot compare present dollars with future dollars unless the two are expressed on the same basis. Future dollars will always be worth less in a present value sense because of the existence of a positive interest rate—in this case the customary practice was followed and a discount rate of 4% was assumed.

Given the assumed discount rate of 4%, by virtue of the positive NPV of some \$30 million, the conclusion can be drawn that the four companies generating royalty revenues represent a significant contribution to the regional economy. The B/C ratio—another way of expressing the ROI—shows that for every dollar of costs incurred, the companies earn \$2.80 in present value terms, again a strongly positive and feasible return on investment.

In Table 8, the cash flows have been confined to the aggregate research expenditures incurred by the four companies on the cost side, and the aggregate royalty and licensing revenues on the revenue side. The results here also indicate strong feasibility as shown by the strong and positive NPV and the 2.4 B/C ratio.

Table 7: ROI Analysis, All Costs and Benefits (\$1000)

Year	Costs	Benefits	NCF
2007	\$3,394.7	\$9,413.1	\$6,018.4
2008	\$3,790.0	\$9,822.2	\$6,032.2
2009	\$3,752.6	\$11,398.8	\$7,646.3
2010	\$3,090.3	\$7,618.0	\$4,527.8
2011	\$4,554.9	\$14,368.0	\$9,813.1
NPV	\$16,489.6	\$46,587,107	\$30,097.5
IRR			NA
B/C			2.8

Table 8: ROI Analysis, Partial Costs and Benefits (\$1000)

Year	Costs	Benefits	NCF
2007	\$1,392.8	\$3,108.2	\$1,715.4
2008	\$1,891.3	\$3,322.6	\$1,431.4
2009	\$1,508.7	\$3,551.4	\$2,042.7
2010	\$1,593.8	\$3,872.5	\$2,278.8
2011	\$1,833.2	\$6,208.5	\$4,375.3
NPV	\$7,298.2	\$17,631.1	\$10,332.8
IRR			NA
B/C			2.4

⁵ The internal rate of return (IRR) could not be measured because of the absence of negative numbers in the Net Cash Flow columns shown in Tables 7 and 8.

The IRR is another way of expressing the ROI of an investment, but in percentage terms. It is perhaps a measure better known since it can be compared, for example, to returns in the stock market. For this cash flow, however, the IRR cannot be computed because the IRR must have at least one negative cash flow in the net cash flow (NCF) column in order to derive a percentage measure. Since 2007, royalty revenues in the aggregate for the four companies have exceeded costs for all of the years. There is therefore no negative cash flow, which makes it impossible to compute the IRR.

3. Out-of-State & International Markets

3.1 Introduction

One measure of benefits to a local or regional economy is net inflows of revenue from business activity. Inflows originating from outside the region support jobs locally and support the local tax base. Inflows also demonstrate the relevance of business activity in the local region to external economies. Economies with large net outflows tend to be non-self-supporting, vulnerable to external forces, and often more volatile.

Using data from the park’s tenants, Table 9 displays the total and percentage revenue inflows for all tenants by year. Inflows are broken down into those originating

from outside the state and those coming from outside the country. Total revenue from all sources (in-state, out-of-state, and out-of-country) is presented at the bottom of the table. It should be noted that the total revenue from all sources was used in prior sections to estimate total jobs, earnings, and fiscal impacts.

3.2 Out-of-State Revenues Generated

Appropriations from North Dakota for the development and operation of the RTP can be compared against out-of-state revenue inflows. This is one way of measuring

Table 9: Out-of-State and International Revenues (\$1000)

Source	2007	2008	2009	2010	2011
out-of-state	\$ 64,168	\$ 96,241	\$ 96,384	\$101,881	\$ 111,778
% of all revenue	67%	73%	70%	70%	65%
out-of-country	\$ 9,579	\$ 10,830	\$ 13,528	\$ 12,369	\$ 16,973
% of all revenue	10%	8%	10%	8%	10%
ALL REVENUE	\$ 95,858	\$132,705	\$ 137,086	\$145,548	\$ 172,810

Table 10. International Markets

North America	Europe	South America	Asia	Oceania	Africa
Canada	Austria	Argentina	India	Australia	South Africa
Mexico	Belgium	Brazil	Taiwan	New Zealand	
	Denmark	Chile	Turkey		
	France	Colombia			
	Germany	Uruguay			
	Great Britain	Venezuela			
	Hungary				
	Italy				
	Netherlands				
	Portugal				
	Spain				
	Switzerland				

the ROI to the citizens of North Dakota. Table 9 shows that 70% of the RTP's annual revenues in 2010 originated from outside the state, amounting to nearly \$102 million. Since 2007, this reflects a growth of approximately 59%. Because more than two-thirds of all revenues generated come from outside the state, it can also be inferred that two-thirds of all jobs, earnings, and local tax revenue generated by the park is paid for by other states.

3.3 International Revenues Generated

The RTP companies trade with nations across six continents, as shown in Table 10. The list does not include all of the nations due to incomplete reporting, yet the number of international trading partners continues to grow from year to year.

Investments into the park by the citizens of North Dakota have generated international impacts. Positive

cash inflows are steadily accruing. In 2007, over \$9 million in revenue flowed into the park, and by 2011, this amount is expected to grow to nearly \$17 million. On a percentage basis, international inflows accounted for 8% of all revenues generated in 2010. Foreign sources will support as projected for 2011 nearly one-tenth of all the RTP's jobs, earnings, and tax contributions.

3.4 Summary

The RTP has a proven track record of directing monies into the local economy from outside sources. As shown in Table 9 for 2010, approximately 78% (70% out-of-state plus 8% international) of all revenues originate from outside of North Dakota. If we include the projected year 2011, out-of-state and international revenues will have grown respectively by an astounding 74% and 77% since 2007.

4. Financial Capital: Incubator Clients and Graduates

4.1 Introduction

One measure of innovative capacity and future profitability is the total amount of grants and related cash infusions into the park. Grantors and investors expect a return on their scarce resources. In some cases, the return is the creation of new knowledge; in other cases, the return is future profitability. Because the pool of grants and related funds is limited, competition for these funds is highly aggressive. If grantors and investors do not receive returns, RTP tenants cannot expect future cash infusions. Thus, the total dollar amount of such funds and how the pool grows or contracts with time is a proxy for performance.

4.2 Grants and Related Cash Infusions

Table 11 compiles the total amount of grant funds, venture capital funds, and angel investor funds received by tenants of the park. Data presented here were supplied by the park's tenants and may be incomplete. The total of these sources is anticipated to swell to over \$16 million in 2011. This equates to a 410% increase over a 5-year period.

What is noteworthy is that the amount of such funds has increased over time. This suggests work enabled by past funding has generated good results, and these results may have encouraged additional investment.

Table 11: Grants and Related Funding Sources (\$1000)

Source	2007	2008	2009	2010	2011 (projected)
Private Grants	\$0	\$1,218	\$1,614	\$1,857	\$723
Other grants, VC Funds, Angel Funds	\$0	\$2,707	\$517	\$7,682	\$15,400
TOTAL	\$0	\$3,926	\$2,133	\$9,539	\$16,123
CUMULATIVE TOTAL					\$31,721

Data Sources

Data for this analysis was provided by the participating RTP companies and the EMSI IO model. Data sources for the IO model are provided in the list below.

U.S. Department of Commerce

Bureau of Economic Analysis

- State Personal Income and Employment
- Local Area Personal Income and Employment
- Industry Economic Accounts, Benchmark and Annual Input-Output (I-O) Accounts

U.S. Census Bureau

- American Community Survey
- County Business Patterns
- ZIP Code Business Patterns
- Nonemployer Statistics
- Local Employment Dynamics (LED)
- TIGER/Line File (with additions by DM Solutions Group)
- Population Estimates
- U.S. National and State Population Projections
- Census 2000 Summary Files 1 and 3 (SF 1, SF 3)

U.S. Department of Labor

Bureau of Labor Statistics

- Quarterly Census of Employment and Wages (QCEW)
- Current Employment Statistics (CES)
- Current Population Survey (CPS)
- Local Area Unemployment Statistics (LAUS)
- National Compensation Survey
- National Industry-Occupation Employment Matrix (10-year, current/projected)
- Occupational Employment Statistics (OES)
- Occupational Education and Training Projections

Employment and Training Administration (ETA)

- Characteristics of the Insured Unemployed
- National O*NET Consortium, O*NET Production Database

U.S. Department of Education, National Center for Education Statistics

- Integrated Postsecondary Education Data System (IPEDS)
- Office of Educational Research and Improvement for the CIP, 2000 Standard Occupational Classification Crosswalk to 2000 Classification of Instructional Programs

U.S. Department of Health and Human Services, National Center for Health Statistics

- Health, United States

U.S. Postal Service

- Address Information Systems (AIS) Products, Delivery Statistics
- AIS Products, 5-Digit ZIP Product
- AIS Products, City State Product

Internal Revenue Service

- Statistics of Income Division, County-to-County Migration Data

U.S. Railroad Retirement Board

- Annual Railroad Retirement Act and Railroad Unemployment Insurance Act Statistical Tables

Private sources

- Indeed.com job-posting search engine
- Nielsen Claritas Business-Facts® (in conjunction with infoUSA™)

Note: In addition to our federal sources, we use state and (where available) sub-state industry projections produced by all 50 individual states.

Appendix 1: EMSI Input-Output Model

Introduction and Data Sources

EMSI’s input-output model represents the economic relationships among a region’s industries, with particular reference to how much each industry purchases from each other industry. Using a complex, automated process, we can create regionalized models for geographic areas comprised by counties or ZIP codes in the United States. Our primary data sources are the following:

1. The Industry Economic Accounts from the Bureau of Economic Analysis (BEA); specifically the “make” and “use” tables from the annual and benchmark input-output accounts.
2. Regional and national jobs-by-industry totals, and national sales-to-jobs ratios (from EMSI’s industry employment and earnings data process).
3. Proprietor earnings from State and Local Personal Income Reports (BEA).

Creation of the National Z Matrix

The BEA “make” and “use” tables (MUTs) show which industries make or use which commodity types. These two tables are combined to replace the industry-commodity-industry relationships with simple industry-industry relationships in dollar terms. This is called the national “Z” matrix, which shows the total amount (\$) each industry purchases from others. Industry purchases run down the columns, while industry sales run across the rows.

Table 1: Sample “Z” matrix (\$ millions)

	Industry 1	Industry 2	...	Industry N
Industry 1	3.3	1,532.5	...	232.1
Industry 2	9.2	23.0	...	1,982.7
...
Industry N	819.3	2,395.6	...	0

The value 1,532.5 in this table means that Industry 2 purchases \$1,532,500,000 worth of commodities and/or services from Industry 1.

The whole table is basically an economic double-entry accounting system, configured so that all money inflows have corresponding outflows elsewhere.

In addition to regular industries (such as “oil and gas extraction,” “machinery manufacturing,” “food and beverage stores,” “hospitals,” and so on), there are three additional rows representing labor earnings, profits, and business taxes, which together represent industry “value added” and account for the fact that industries do not spend all of their income on inputs from other industries. There are also three rows and columns representing federal, state, and local government (we later separate federal government into civilian and military sectors).

We create two separate Z matrices since there are two sets of MUTs—annual and benchmark. The benchmark data are produced every five years with a five-year lag and specify up to 500 industry sectors; annual data have a one-year lag but specify only 80 industrial sectors.

The basic equation is as follows:

$$Z = VQ^{-1}U$$

where V is the industry “make” table, Q^{-1} is a vector of total gross commodity output, and U is the industry “use” table.

In reality, this equation is more complex because we also need to “domesticate” the Z matrix by removing all imports. This is needed because we are creating a “closed” type of national model.

In addition, there are a number of modifications that need to be made to the BEA data before the calculations can begin. These are almost all related to the conversion of certain data in BEA categories to new categories that are more compatible with other data sets we use in the process, and describing them in detail is beyond the scope of this document.

Disaggregation of the National Z Matrix

The previous step resulted in two national Z matrices—one based on the benchmark BEA data (five years old, approximately 500 industries) and the other based on the annual BEA data (one year old, but only about 80 industries). These initial national Z matrices are then combined and disaggregated to 1,125 industry sectors. Combining them allows us to capitalize on both the recency of the annual data and the detail of the benchmark data. The disaggregation is performed for each initial Z matrix using probability matrices that allow us to estimate industry transactions for the more detailed sectors based on the known transactions of their parent sectors. The probability matrix is created from detailed EMSI industry earnings data, which are available for all 1,125 sectors and are created using a separate process.

Creation of the National A Matrix

The national disaggregated Z matrix is then “normalized” to show purchases as percentages of each industry’s output rather than total dollar amounts. This is called the national “A” matrix.

Each cell value represents the percentage of a row industry’s output that goes toward purchasing inputs from each column industry. Thus, the cell containing .112 above means that Industry 1 spends 11.2% of its total output to obtain inputs from Industry 2.

Table 2: Sample “A” matrix

	Industry 1	Industry 2	...	Industry 1125
Industry 1	.001	.112035
Industry 2	.097	0065
...
Industry 1125	.002	.076	...	0

At this point, our additional rows representing earnings, profits, and business taxes are removed. However, we will use them in a different form later.

Regionalization of the A Matrix

To create a regional input-output model, we regionalize the national A matrix using that region’s industry mix.

The major step in the process is the calculation of per-industry out-of-region exports. This is performed using

a combination of the following standard techniques that are present in the academic literature:

1. Stevens regional purchase coefficients (RPCs)
2. Simple location quotient of value added sales
3. Supply/demand pools derived from the national A matrix

We try to maximize exports in order to account as fully as possible for “cross-hauling,” which is the simultaneous export and import of the same good or service to/from a region, since it is quite common in most industries.

Another major part of the process is the regionalization of consumption, investment, and local government “row industries” (rows referring to the rows of the A matrix). These represent the percentage of each industry’s sales that end up going toward consumption, capital purchases, and taxes to local government, respectively. They are created from the “value added” rows that we removed earlier. Consumption is calculated using each industry’s earnings and profits, as well as a constant called “the average propensity to consume,” which describes the approximate percentage of earnings and profits that are spent on consumption. Investment and local government rows are calculated by distributing the known total investment and endogenous local government for the entire region to individual industries proportionally to their value added.

The A-matrix regionalization process is automated for any given region for which industry data are available. Although partially derived from national figures, the regional A matrix offers a best possible estimate of regional values without resorting to costly and time-consuming survey techniques, which in most cases are completely infeasible.

Creating Multipliers and Using the A Matrix

Finally, we convert the regional “A” matrix to a “B” matrix using the standard Leontief inverse $B = (I - A)^{-1}$. The “B” matrix consists of inter-industry sales multipliers, which can be converted to jobs or earnings multipliers using per-industry jobs-to-sales or earnings-to-sales ratios.

The resulting tables and vectors from this process are then used in the actual end-user software to calculate regional requirements, calculate the regional economic base, estimate sales multipliers, and run impact scenarios.