Kansas State University

Program Approval
I. General Information

A. Institution:	Kansas State University
B. Program Identification	
Degree Level:	Bachelor's
Program Title	Integrated Computer Science
Degree to be Offered:	Bachelor of Science & Bachelor of Arts in Integrated Computer Science
Responsible Unit:	College of Arts & Sciences
CIP Code:	11.0199
Modality:	Hybrid
Proposed Implementation:	Fall 2020

Total Number of Semester Credit Hours for the Degree: 120 (both BA and BS)

II. Clinical Sites: Does this program require the use of Clinical Sites? No

III. Justification

Integrated Computer Science (ICS) combines computer science with domain knowledge from some area of concentration. The degree integrates a concentration from any field of study outside of computer science with computational skills, complementary electives, and a capstone project applying those skills to the concentration area. Integrated Computer Science equips students for a wide variety of possible careers and to become academic, cultural, and industrial leaders who integrate an arts and sciences education with expertise in computer science.

With each passing year, computers play a larger role in our lives. Software shapes how we shop, communicate, vote, collaborate, and even how we think. However, the supply of software developers has not kept pace with demand, and many with computer skills lack the complementary skills that a broad education in the Arts & Sciences supplies: appreciation of aesthetics and design, understanding of our collective human history, insight into social, economic, and psychological effects of software design, and the ability to understand the dynamics of teamwork and cooperation in a software design workspace. At the same time, computational skills are increasingly important across the arts and sciences, in applications ranging from using live data streams to create cutting-edge art to computationally modeling complex biological processes. Indeed, many of our own faculty are re-skilling by learning computer coding to advance their research and creative activities.

What sets this program apart from others is a computer science track that is pragmatic rather than theoretical and based on algebra rather than calculus. This captures students who can benefit and excel within this program and encourages students to attain multi-disciplinary skill and expertise. It will be these unique and high-in-demand combinations that sets our students apart in the job marketplace and equips them to pursue their passions.

We envision graduates entering a wide range of fields, not merely as software engineers but as business leaders, scientists, artists, journalists, and scholars with the software engineering skills that are increasingly essential everywhere. We will produce artists who code, scientists leveraging algorithm-driven models, journalists who dig deep into big data, and entrepreneurs who design and prototype their ideas themselves. A combination of core competency in computer programming, database management, and algorithms along with a broad Arts and

Sciences education will serve to create ethical leaders, smart citizens, and skilled employees for advancing the well-being of Kansas, the nation, and the world.

Specifically, this program will prepare students to:

- use in-demand programming languages and software design techniques to address real-world problems in a wide variety of fields;
- leverage programming and database integration skills to advance their career and contribute to their chosen field of concentration;
- consider the broader humanistic and scientific context of problems encountered in software development, and use appropriate domain knowledge to find solutions;
- enter the workforce with a solid core of in-demand computing skills, making them much more employable and effective; and
- understand and abide by the highest ethical standards of their profession and think clearly about the moral dimensions of their work.

IV. Program Demand: Market Analysis

The primary markets for this major include:

- on-campus students who wish to combine computer science with another field, as well as students who struggle with or dislike the advanced mathematics required for a pure computer science major; and

- online students pursing a cost-effective credential, including distance and transfer students with 60+ hours of college credit as well as alumni adding an additional degree that can build on (and accept credits from) their previous degree.

On-Campus Market Analysis: At Kansas State, there has been a 137% increase in computer science majors over the past decade, despite enrollment caps due to limited seating. Online demand, where physical seating is not a restriction, will to continue to grow. Furthermore, we have seen substantial growth in non-majors combining their chosen fields of study with computer science courses. Nearly 100 non-majors per year enroll in our introductory computer science course.

Across the nation from 2005 to 2015, in courses primarily intended for computer science majors, non-major enrollment grew faster than major enrollment. In introductory courses, major enrollment increased 152%, non-major enrollment by 177%. Similar trends hold for mid-level (majors: 152%; non-majors: 251%) and upper-level courses (majors: 165%; non-majors: 143%) (Computer Research Associates, 2017).

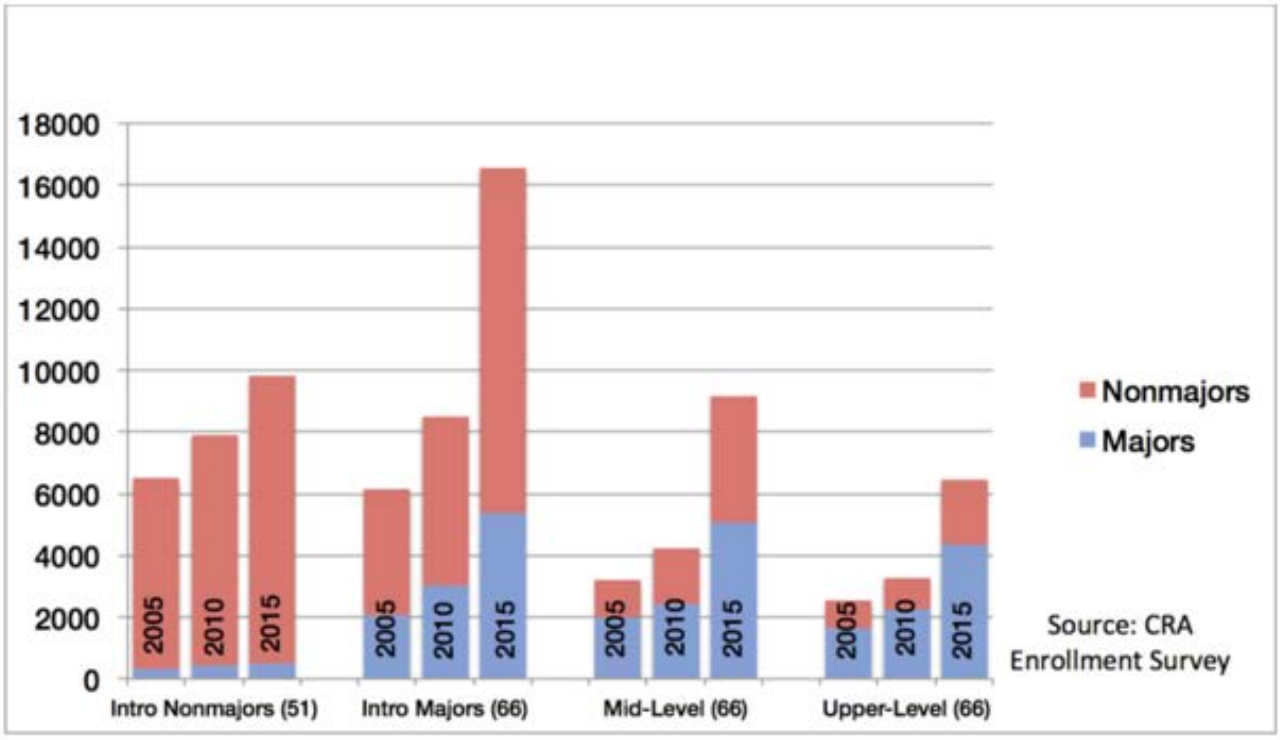

Figure 1. Cumulative nonmajor enrollment (red) and major enrollment (blue) in computing courses at doctoral- and non-doctoral granting units from 2005 to 2015.

(Source: Computer Research Associates, 2017)

We estimate that 150 on-campus students not majoring in Computer Science would pursue advanced courses in computer science, and that this number will increase.

Online Market Analysis:

Computer science is nationally one of the most popular areas of study for online students. According to a Babson/Learning House study of online student preferences, computer science is third among all desired undergraduate majors (Babson Survey Research Group, 2018). Business and psychology remain ahead, but their share of student interest has declined while the computer science share has increased, to 14% of the current total undergraduate online market.

The Educational Advisory Board (EAB) was tasked with finding the best opportunities for online program growth for Kansas State specifically. They identified bachelor's level Computer Science as the leading opportunity: *"Prioritize the development of online bachelor's-level computer science programming. The Forum finds computer science occupations most commonly require a bachelor's degree"* (EAB Global, 2018).

The online bachelor's degree market is not saturated. In 2018, IPEDS reported 27,553 completed computer science bachelor's degrees (EMSI, 2020). Only 6% of these completions were online. There are only 33 online competitors for bachelor's degrees in computer science in the nation.

Program Overview

	Completions (2018)	% Completions	Institutions (2018)	% Institutions
All Programs	27,553	100%	604	100%
Distance Offered Programs	1,777	6%	30	5%
Non-Distance Offered Programs	25,776	94%	574	95%

Figure 2. EMSI Labor Analysis (EMSI, 2020)

EMSI labor analysis also indicated there are over 150,000 annual openings across the United States calling for a computer science background. This means there are *far* more new jobs each year than new degree holders to fill them.

Among the 33 online programs, IPEDS reports an average graduating cohort of 54 students. Programs most similar to ours are much larger. We expect our numbers to be in line with our peer institutions charted below (all are online programs):

Institution	Bachelor's Degree Completions	Growth % (2017)	Market Share (2017)
Oregon State University	495	58.1%	27.8%
University of Minnesota-Twin Cities	345	3.0%	19.4%
University of Utah	125	Insufficient Data	7.0%
University of Illinois at Springfield	96	(5.0%)	5.4%
Lewis University	73	108.6%	4.1%

The example of Oregon State University is notable, as they have the highest number of degree completions, as well as the fastest growth. Their model is similar to K-State's proposed model. They created an online "Professional Computer Science" degree, marketed to liberal arts majors who find themselves underemployed or seeking a different career. Students can complete only the core courses for the degree regardless of where they did their initial undergraduate program and can finish the program in as little as one year. Since inception in 2013, Oregon State has graduated over 900 students and shows a current growth rate of over 58%. They report nearly 1,500 students currently enrolled in the program (EMSI, 2020).

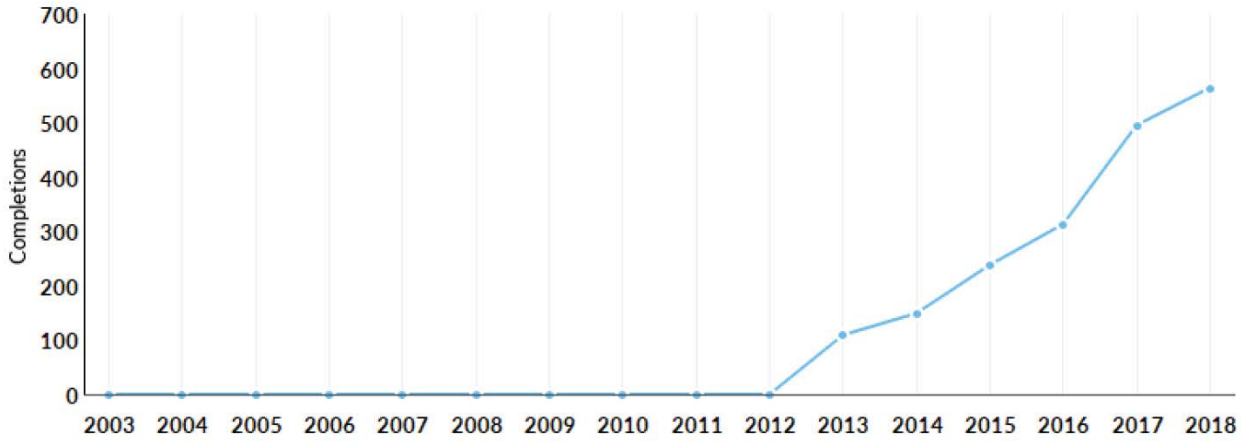

Figure 3. Oregon State University Completions in Computer Science (EMSI, 2020)

V. Projected Enrollment:

The numbers above suggest that we could have over 1,000 students enrolled in the program within four years. For this reason, we have prepared a scalable set of courses for all of our requirements that can accommodate a large influx of students as needed.

We have also performed several budget simulations based on much lower numbers to minimize our risk and examine the program viability. Our low estimates of enrollment are as follows:

Year	**Headcount Per Year**		**Sem Credit Hours Per Year**	
	Full- Time	**Part- Time**	**Full- Time**	**Part- Time**
Implementation	20	4	520	48
Year 2	30	6	1,440	120
Year 3	40	8	2,610	216

We believe this is a *very* conservative estimate for the students. We have contingency plans for the number of students enrolled in the ICS program to be much greater than the estimates described above. Due to our approach of using individualized, online instruction, the program can be expanded (or shrunk) very quickly. Instructors will be hired on term appointments and GTAs (and possibly undergraduate teaching assistants) will be hired one semester at a time.

VI. Employment

A 2018 market research brief from EAB found over 90,000 regional job listings in the field of computer science (EAB Global, 2018). Yet across the entire nation, we produce less than a third of that many computer science graduates. Importantly, 70% of those jobs are outside the traditional tech sector. Our students, with an ability to apply computer science to a wide range of fields, will be well-positioned for this emerging job market.

Table 1. Bureau of Labor Statistics for Software Developers

(U.S. Bureau of Labor Statistics, 2020)

2019 Median Pay	$107,510 per year
Typical Entry-Level Education	Bachelor's degree
Work Experience in a Related Occupation	None
On-the-job Training	None
Number of Jobs, 2018	1,365,500
Employment Change, 2018-28	284,100

Employers ***in our region*** posted **213%** more job openings for 'computer and information research scientists' in 2018 than in 2014. Job openings increased **65%** for 'information security analysts' (16,956 postings), **46%** for 'computer systems engineers/architects' (28,184 postings), and **45%** for 'software developers, applications' (104,201 postings) (U.S. Bureau of Labor Statistics, 2020).

The Bureau of Labor Statistics projects significant growth for related fields over the next eight years, as compared to a projected 7% national average for all occupations:

- **31%** for Software Developers
- **28%** for Information Security Analysts
- **19%** for Computer and Information Research Scientists
- **13%** for all computer occupations

Further, employers demonstrate high demand for related skills including Information security (20,713 job postings), Python (43,049), and Software development (75,277).

VII. Admission and Curriculum

A. Admission Criteria

Normal Kansas State University admissions criteria for incoming, transfer, and international students will apply for the proposed program. No additional criteria are included.

B. Curriculum

The curriculum consists of 29 credits in computer science, along with a 12-credit core in the College of Arts & Sciences that will introduce students to applications of computer science in the digital arts and humanities, the cultural impacts of technology, and moral reasoning and professional ethics in integrated computer science. In addition, all students must complete a concentration with at least 18 credits in a single field, or the interdisciplinary concentration. In the sample curriculum below, the concentration is in philosophy, and the degree is completed as a BS. Completion as a BA would require a foreign language requirement at the fourth level, and involve slightly different general education courses in social sciences and humanities, but would otherwise be similar.

Year 1: Fall **Semester Credit Hours**

Course #	Course Name	SCH = 13
ENGL100	Expository Writing I	3
CC110	Introduction to Computing	3
CC210	Fundamental Programming Concepts	4
ANTH204	Introduction to Cultural Anthropology	3

Year 1: Spring

Course #	Course Name	SCH = 13
BIOL198	Principles of Biology	4
AMETH160	Introduction to American Ethnic Studies	3
CC310	Data Structures and Algorithms I	3
ENGL200	Expository Writing II	3

Year 2: Fall

Course #	Course Name	SCH = 17
PHILO386	Philosophy of Computer Science and Software Engineering	3
CC315	Data Structures and Algorithms II	3
CHM110	General Chemistry	3
COMM106	Public Speaking I	3
BIOL201	Organismic Biology	5

Year 2: Spring

Course #	Course Name	SCH = 16
PHILO305	Reasons, Decisions and Society	3
PHILO330	Moral Philosophy	3
CC410	Advanced Programming	4
POLSC135	Intro Comparative Politics	3
XXX	ELECTIVE	3

Year 3: Fall

Course #	Course Name	SCH = 15
CC510	Computer Systems Administration	3
PHILO303	Writing Philosophy	3
PHILO320	Symbolic Logic I	3
MATH205	General Calculus and Linear Algebra	3
PHILO492	Computers and Society	3

Year 3: Spring

Course #	Course Name	SCH = 14
PHILO345	Worlds, Things and Properties	3
PHILO301	History of Philosophy	3
CC560	Database Essentials	3
PHILO340	Justification and Reliable Knowledge	3
XXX	ELECTIVE	2

Year 4: Fall

Course #	Course Name	SCH = 17
CC535	Applied Data Science	3
MUSIC250	Music Appreciation	3
PHYS115	Descriptive Physics	5
ENGL603	Topics In Linguistics	3
XXX	ELECTIVE	3

Year 4: Spring

Course #	Course Name	SCH = 15
ENGL326	Introduction to the Digital Humanities	3
PHILO510	Symbolic Logic II	3
HIST311	Race and US Foreign Relations	3
CC590	Topics in Applied Computer Science	3
XXX	ELECTIVE	3

Total Number of Semester Credit Hours ……..120

VIII. Core Faculty FTE: 1.0 FTE = Full-Time Equivalency Devoted to Program

The core faculty for the Integrated Computer Science program consists of Dr. Michael Wesch (who will also be the program administrator), core faculty from Arts & Sciences who teach the core ICS A&S courses, and five faculty from Computer Science. There will be many more faculty involved that are not included here who are already teaching other degree courses as part of existing programs. These faculty represent the core faculty who will meet regularly to guide and assess the program.

Faculty Name	Rank	Highest Degree	Tenure Track Y/N	Academic Area of Specialization	FTE to Proposed Program
* Michael Wesch	Professor	PhD	Y	Anthropology	0.25
Graham Leach-Krouse	Associate Professor	PhD	Y	Philosophy	0.125
Mark Crosby	Associate Professor	PhD	Y	English	0.125
Ryan Klataske	Instructor	PhD	N	Anthropology	0.125
Russell Feldhausen	Instructor	MS	N	Computer Science	0.375
Emily Alfs-Votipka	Instructor	MS	N	Computer Science	0.375
Joshua Weese	Teaching Assistant Professor	PhD	N	Computer Science	0.125
Lior Shamir	Associate Professor	PhD	Y	Computer Science	0.125
Nathan Bean	Instructor	MS	N	Computer Science	0.125

* Denotes Program Administrator

Number of graduate assistants assigned to this program …… 3 (after YR 2)

IX. Expenditure and Funding Sources

A. EXPENDITURES	First FY	Second FY	Third FY
Personnel – Reassigned or Existing Positions			
Faculty	$146,295	$149,221	$152,205
Administrators *(other than instruction time)*	$19,662	$20,956	$21,255
Graduate Assistants	$32,000	$40,800	$49,939
Support Staff for Administration (*e.g., secretarial*)	$12,000	$12,240	$12,485
Fringe Benefits *(total for all groups)*	$58,466	$61,229	$63,747
Other Personnel Costs			
Total Existing Personnel Costs – Reassigned or Existing	$268,423	$284,446	$299,631
Personnel – – New Positions			
Faculty			
Administrators *(other than instruction time)*			
Graduate Assistants			
Advising (.5 FTE)	$30,000	$30,600	$31,212
Fringe Benefits *(total for all groups)*			
Other Personnel Costs			
Total Existing Personnel Costs – New Positions	$30,000	$30,600	$31,212
Start-up Costs - - One-Time Expenses			
Library/learning resources	-	-	-
Equipment/Technology	-	-	
Physical Facilities: Construction or Renovation	-	-	-
Total Start-up Costs	$0	$0	$0
Operating Costs – Recurring Expenses			
Supplies/Expenses	$6,300	$12,600	$21,000
Library/learning resources	$6,250	$6,250	$6,250
Equipment/Technology	-	$25,000	$25,000
Travel	-	-	-
Codio (online learning platform) Fees	$2,642	$6,528	$11,543
Total Operating Costs	$15,192	$50,378	$63,793
GRAND TOTAL COSTS	$313,615	$365,424	$394,636

B. FUNDING SOURCES (projected as appropriate)	Current	First FY (New)	Second FY (New)	Third FY (New)
Tuition / State Funds		$177,812	$487,500	$883,125
Student Fees		$46,902	$128,153	$232,287
Other Sources (Global Campus)		$16,974	$46,338	$84,004
GRAND TOTAL FUNDING		$241,688	$661,991	$1,199,416
C. Projected Surplus/Deficit (+/-) (Grand Total Funding minus Grand Total Costs)		($71,927)	$296,567	$804,780

X. Expenditures and Funding Sources Explanations

A. Expenditures

Personnel – Reassigned or Existing Positions

All core faculty are currently employed by Kansas State University in the College of Arts & Sciences or College of Engineering. All ICS faculty teach either the core computer science courses (CC 110, CC 210, CC 310, CC 315 and CC 410) or advanced courses (CC 500 and above). Computer Science faculty who teach the core courses (Feldhausen and Alfs-Votipka) teach only online computational core courses, which are used in this degree. Faculty who teach advanced computer science courses (with the exception of Feldhausen) split their teaching time between the traditional Computer Science program and the Integrated Computer Science program (at approximately 33% devoted to integrated computer science courses). All core Computer Science faculty except for Shamir and Weese are already assigned to teach the listed courses as part of their current appointments. Shamir and Weese will start teaching their new courses in year 2. Shamir is already scheduled to increase his teaching load by one course in 2021-2022 and Weese will have additional capacity due to the phasing out of an existing course. No additional faculty or instructor hires are required to initiate or maintain the new program unless program enrollment grows substantially. The percent time dedicated to the program varies by faculty member and the courses taught each year by applying a general rule of 0.125 FTE per in-person course or 0.0625 FTE per online course for 9-month faculty and 0.0417 FTE per online course. Dr. Michael Wesch will assist the Dean of the College of Arts and Sciences in administering the program. This effort is included in the faculty salary line of the budget as one summer month of pay each year. For budgeting purposes, all salaries (faculty, graduate teaching assistants, and administrative support) include a modest 2% pay increase after the first fiscal year.

Computer Science graduate teaching assistants (GTAs) will be required for all computer science courses greater than 20 students, with additional GTAs required for every additional 40 students. Computer science programs and projects are similar to English compositions and works of art in that each are unique and require a great deal of effort to understand and to provide feedback for. Computer Science GTAs are typically paid between $650 and $800 biweekly (depending on degree status). In addition, undergraduate teaching assistants (UTAs) are often used to work with students one-on-one during laboratory help sessions and can be used to help reduce the number of GTAs required per course. UTAs have proven to be very effective in this role as they recently were taking the same courses and struggling with the same concepts. UTAs are normally paid between $11 and $15 per hour.

Personnel – New Positions

The budget includes support for an advisor position in the College of Arts and Sciences at .5 FTE. This is appropriate support for an estimate of up to 100 majors in the first three years. Adjustments may be necessary to accommodate further growth.

Start-Up Costs – One-Time Expenses

There are no additional one-time startup expenses associated with the program.

Operating Costs – Recurring Expenses

The cost of the Codio (computer science specific) online learning platform is $48 per student per semester. This cost will be covered by an existing $19 per credit hour College of Engineering Equipment Fee that is charged to all students taking computer science courses.

B. Revenue: Funding Sources

The following revenue table assumes that approximately 76% and 24% of all semester credit hours (SCH) are generated by the College of Arts and Sciences (COAS) and the College of Engineering (COE) respectively. All courses from the COE are online and offered through K-State's Global Campus, hence the "hybrid" modality of this proposed degree program.

This analysis assumes that all students will be on-campus students, although the program can be taken completely or partially online. Thus, it is highly likely that there will also be students who will be taking the program online, including both COAS and COE courses. These students will generate even more revenue than our analysis shows.

COAS has a general fee of $16.70 per credit hour for on-campus courses, while the COE has a general fee of $80 per credit hour, equipment fee of $19 per credit hour, and distance education fee of $190.70 per credit hour. All funds generated by fees will be retained by the generating college depending on the specialization chosen by the student, this percentage could change and may involve courses from additional KSU colleges such as the College of Agriculture, College of Architecture, Planning, and Design, College of Business, College of Veterinary Medicine, and/or Staley School of Leadership Studies. The fee structures for these schools are not factored into this budget analysis.

Tuition & Fees	Tuition /SCH	YR 1 SCH= 568	Sub-Totals	YR 2 SCH= 1560	Sub-Totals	YR 3 SCH= 2826	Sub-Totals
In-State On-Campus Tuition	$312.50	432	$135,000	1186	$370,625	2148	$671,250
Global Campus Tuition	$312.50	137	$42,812	374	$116,875	678	$211,875
COAS Fees	$16.70	432	$7,214	1186	$19,806	2148	$35,871
COE Fees	$99.00	137	$13,563	374	$37,026	678	$67,122
COE GC Fees	$190.70	137	$26,125	374	$71,321	678	$129,294

Global Campus Fees	$123.90	137	$16,974	374	$46,338	678	$84,004
Total Revenue			$241,688		$661,991		$1,199,416

C. Projected Surplus/Deficit

Our estimate suggests that this program will be highly profitable from the second year due to the use of existing courses and the hybrid delivery approach. Projected surpluses are also sufficient to maintain appropriate IT support infrastructure throughout the lifetime of the program at no additional cost to the university.

XI. References

Babson Survey Research Group. 2018. Online College Students: comprehensive data on demands and preferences. Download from https://onlinelearningsurvey.com/reports/gradeincrease.pdf. Last accessed April 23, 2020.

Computer Research Associates. 2017. https://cra.org/data/generation-cs/. Last accessed April 23,2020.

EAB Global, Inc. 2018. Market Research Brief: Online Program Opportunity Analysis for Kansas State University (Analysis of Regional Employer Demand and Peer Institution Offerings).

EMSI Economic Model tool. http://economicmodeling.com/ retrieved April 23, 2020.

US Bureau of Labor Statistics. https://www.bls.gov/ooh/computer-and-information-technology/software-developers.htm, last accessed April 23, 2020